calsense

CS3000
DESIGNER'S GUIDE

Disclaimer

The information contained in this document is true and correct as of the date of publication. The information is subject to change at any time without notice.

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Calsense Overview

Calsense uses the power of data and smart technologies to usher in a new era of irrigation management solutions for its customers and the planet.

The company began its journey in irrigation management over 35 years ago by providing central control for landscape irrigation across a diverse set of customers, including municipalities, K-12 school districts, departments of transportation, university campuses, HOAs and more. Calsense has earned a reputation for cost-effective solutions that enhance the beauty and health of its customers' landscapes. With the need for water and labor conservation universally recognized, Calsense's data-driven approach is needed more than ever.

The Calsense CS3000 Designer's Guide provides detailed design information for the Calsense CS3000 product line. Please call Calsense directly at (760) 438-0525 for more information and product support. The hours of operation are Monday through Friday, 8:00 AM to 5:00 PM Pacific Time.

Calsense Service

Beyond products that are well-featured, durable, and long-lasting, Calsense provides customers with a celebrated level of after-sales training and support, including a centralized customer support helpdesk and a field-based organization throughout the United States. Expert field support personnel help customers' installation and maintenance teams learn the operation of all Calsense products, including Calsense's centralized, cloud-based management application, Command Center Online. In the end, Calsense is focused on helping customers save the world's most precious resource: water.

Irrigation Management as a Service (IMaaS)

IMaaS™ (Irrigation Management as a Service™), as an option, offers customers a turnkey solution that can include smart irrigation hardware, software, and services, without an up-front capital cost. Historically, irrigation equipment required a significant capital spend before users saw any benefits; and often, because capital budgets were limited, the rollout took years, meaning customers saw limited value in the early stages of the project. IMaaS on the other hand, enables a full rollout up-front, so that customers can see 100% of the value of smart irrigation right away. And, with water and labor savings the de facto result of smart irrigation projects, the financial benefits of smart irrigation can be used to help fund the annual as a service fee.

Calsense's Irrigation Management as a Service can include components provided by Calsense and its contractors and/or components provided by the customer's team, depending on current and anticipated staffing levels and organizational priorities. A Calsense technical sales representative will perform a site survey and propose a specific solution, at which point the scope of work will be fully discussed, vetted, and documented as part of the master service agreement (MSA). Once all details have been agreed upon, Calsense will assign a project manager, who will develop and manage the implementation team's activities.

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How to Specify

Specifications include hardware, options, communications, and ancillary parts for each system. The section below provides a brief overview of all available Calsense products.

How to Read Part Numbers

Stations ──────┐   ┌────── Enclosure type

Controller model ──────┐ │   │ ┌────── # of antennae

CS3000-24-WM1
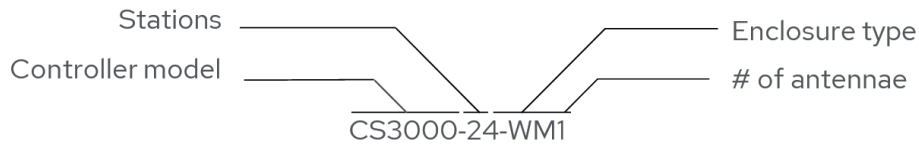
Part Numbers & Descriptions

Controller Model

Part #	Description
CS3	CS3000 base model with transient protection and field replaceable modules

Stations

Part #	Description
-8	8-station base model with support for one conventionally wired POC
-16	16-station base model with support for one conventionally wired POC
-24	24-station base model with support for one conventionally wired POC
-32	32-station base model with support for one conventionally wired POC
-40	40-station base model with support for one conventionally wired POC
-48	48-station base model with support for one conventionally wired POC
-2W	2-Wire base model with support for up to 128 2-Wire stations

Enclosure

All enclosures include transient protection with field-replaceable modules and the option of zero, one, or two pre-drilled antenna holes if ordered with a communication kit that includes surface-mount STUBBY antenna(s).

Part #	Description
-WM	Wall-mount stainless-steel powder-coated enclosure
-S	Heavy-duty, stainless-steel pedestal enclosure
-SD	Double-wide, heavy-duty, stainless-steel pedestal enclosure for two CS3000 controllers*
-SL	Double-wide heavy-duty stainless-steel pedestal enclosure for one CS3000 controller and one solar battery with charging equipment. Only available as an 8-station base model, though additional stations can be added using the CS3-8STA-KIT part.
CS3-SL-POLE	16' pole for mounting Calsense solar panel

CS3-SSBP	22" x 32" stainless-steel back panel for indoor wall mounting. Fully assembled with TP-110, GFI, and receptacle
CS-SB16-KIT	Strong Box SB-16SS retrofit kit to install controller in an existing Strong Box SB-16SS stainless-steel enclosure. Includes stainless-steel controller faceplate bracket and back plate adapter
CS3-S-RETRO-KIT	CS3000 SSE retrofit kit to install CS3000 controller in an existing Calsense Stainless-Steel Enclosure. Includes stainless-steel backplate with pre-mounted backplane for field-replaceable modules, TP-110, on/off switch, and GFI outlet.
SSE-PED	Heavy-duty stainless-steel pedestal for metered enclosure mounting. Requires Strong Box Stainless Steel Meter Pedestal (MPS) and Calsense mounting templated - supplied by others

*Double-wide stainless-steel pedestal enclosures are available in the following configurations. Other options to be specified separately:

Part #	Description
CS3-8	Includes two (2) side-by-side CS3000 base model irrigation controllers with 8 conventionally wired station outputs and supports one conventionally wired POC
CS3-2W	Includes two (2) side-by-side CS3000 2-Wire base model irrigation controllers with support for up to 128-stations each using 2-Wire Station Decoders
CS3-8-2W	Includes two (2) CS3000 irrigation controllers: one 8-station base model and one 2-Wire, mounted side-by-side. 8-station model supports a single conventionally wired POC and up to 48 conventionally wired stations with additional 8-station modules. 2-Wire model supports up to 128-stations using 2-Wire Station Decoders.

How to Specify Optional Equipment

Communication Options

Part #	Description
CS3-GR-KIT	4G LTE cellular modem for CS3000 to communicate with cloud-based Command Center Online web application. Includes GR-STUBBY antenna. Requires Calsense cellular data plan, purchased separately
CS3-WEN-KIT	Wi-Fi device for CS3000 to communicate with cloud-based Command Center Online using an existing Wi-Fi network. Includes WEN-STUBBY antenna
CS3-EN	Ethernet device for communicating with cloud-based Command Center Online using an existing Ethernet network
CS3-SR-KIT	Spread spectrum radio for wireless communication between CS3000 controllers. Includes SR-STUBBY antenna
CS3-M-KIT	Hardwire communication card and terminal board for communication between controllers using Paige P7171D communication cable. For controllers in wall-mount enclosures (models -WM, -WM1, and -WM2)
CS3-MSSE-KIT	Hardwire communication card and terminal board for communication between controllers using Paige P7171D communication cable. For controllers mounted in heavy-duty stainless-steel and double-wide pedestals (models -S, -S1, -S2, -SD, -SD1, -SD2-, and -SD3)
CS3-GR	4G LTE cellular modem for communication with cloud-based Command Center Online web application. Requires stick or yagi antenna and Calsense data access service plan, purchased separately.

CS3-WEN	Wi-Fi device for communication with Command Center Online through an existing Wireless Ethernet (Wi-Fi) network. Requires stick or yagi antenna, purchased separately
CS3-SR	Spread spectrum radio for wireless communication between controllers. Requires antenna, purchased separately
CS3-RR	Current generation rugged smartphone for use as CS3000 remote. Includes 1-year prepaid data plan (model COMM-1YR-RR)

Communication Hubs

Part #	Description
CS3-HUB-WM	Calsense CS3000 communication hub in a wall-mount enclosure to share a single central link with multiple controllers using Local Radio or Spread Spectrum Radio. Requires two communication options. Enclosure includes pre-drilled antenna hole(s) if ordered with communication kit(s) that includes STUBBY antenna(s)
CS3-HUB-S	Calsense CS3000 communication hub in a heavy-duty stainless steel pedestal enclosure to share a single central link with multiple controllers using Local Radio or Spread Spectrum Radio. Hub requires two communication options. Enclosure includes pre-drilled antenna hole(s) if ordered with communication kit(s) that include STUBBY antenna(s)

Field-Replaceable Add-on Modules

Part #	Description
CS3-2WIRE-OPT	2-Wire terminal with cover. Used to add up to 80 2-wire stations and/or 2-Wire POC decoders to a conventionally wired base model CS3000 controller
CS3-FL	*FLOWSENSE*® option for sharing flow, programming, weather data, and cloud communication among multiple controllers. Each controller requires a *FLOWSENSE*-compatible communication option such as hardwire (CS3-M-KIT and CS3-MSSE-KIT) or spread-spectrum radio (CS3-SR).
CS3-HUB-OPT	Share a single central link with multiple controllers using Local Radio or Spread Spectrum Radio. Hub requires two communication options
CS3-8STA-KIT	8-station add-on card and terminal board to add up to eight conventionally wired stations to an existing controller. A single CS3000 supports up to six kits for a total of 48 stations.
CS3-W-KIT	Weather card and terminal board to allow connection of ET gages, rain bucket (model RB-1), wind gage (model WG-1), third-party rain switch, and/or third-party freeze switch
CS3-POC-KIT	POC card and terminal board used to add a conventionally wired POC (master valve and flow meter) to a 2-wire controller
CS3-L-KIT	Lights card and terminal board to for operation of up to four independent light circuits

2-Wire Decoders

Part #	Description
CS-2W-2ST	2-Wire Station Decoder with 2-station outputs

| CS-2W-POC | 2-Wire Point-Of-Connection (POC) Decoder with one flow meter input and one master valve output |
| CS-2W-MOIST | 2-Wire Moisture Sensor Decoder with one station output and attached moisture sensor. Measures soil moisture, temperature, and salinity |

Transient Protection

Part #	Description
TP-110	AC line protection

Weather Sensors

Part #	Description
RB-1	Tipping Rain Bucket
WG-1	Wind Gage

Flow Sensors

Part #	Description
FM 1B	1" brass tee-mounted flow meter
FM 1.25B	1.25" brass tee-mounted flow meter
FM 1.5B	1.5" brass tee-mounted flow meter
FM 2B	2" brass tee-mounted flow meter
FMBX	Insertion-style flow meter for 3-inch and larger pipe. Screws into 2-inch NPT pipe saddle (not included)
FM 1.5	1.5" PVC schedule 80 tee-mounted flow meter
FM 2	2" PVC schedule 80 tee-mounted flow meter
FM 3	3" PVC schedule 80 tee-mounted flow meter
FM 1U	1" PVC schedule 80 tee-mounted ultrasonic flow meter with extended five-year limited warranty
FM 1.5U	1.5" PVC sch 80 tee-mounted ultrasonic flow meter with extended five-year limited warranty
FM 2U	2" PVC sch 80 tee-mounted ultrasonic flow meter with extended five-year limited warranty
FM 3U	3" PVC sch 80 tee-mounted ultrasonic flow meter with extended five-year limited warranty
FM 4U	4" PVC sch 80 tee-mounted ultrasonic flow meter with extended five-year limited warranty
FM 6U	6" saddle with ultrasonic flow meter for ASME pipe. Includes extended five-year limited warranty. Comes with sensor, saddle, gasket, and two clamps
FM 8U	8" saddle with ultrasonic flow meter for ASME pipe. Includes extended five-year limited warranty. Comes with sensor, saddle, gasket, and two clamps
FM 10U	10" saddle with ultrasonic flow meter for ASME pipe. Includes extended five-year limited warranty. Comes with sensor, saddle, gasket, and two clamps

Part #	Description
FM 12U	12" saddle with ultrasonic flow meter for ASME pipe. Includes extended five-year limited warranty. Comes with sensor, saddle, gasket, and two clamps

Antennas and Communication Accessories

Part #	Description
GR-STICK-5	Cellular stick antenna operating at 5 dBi. Does not include antenna cable
GR-STUBBY	Cellular surface-mount antenna with 3' antenna cable
GR-YAGI-11	4G LTE high-gain directional Yagi antenna operating at 11 dBi. Does not include antenna cable
SR-STICK-6	Spread Spectrum Radio omni-directional stick antenna operating at 6 dBi. Does not include antenna cable
SR-STICK-8	Spread Spectrum Radio omni-directional stick antenna operating at 8 dBi. Does not include antenna cable
SR-STUBBY	Spread Spectrum Radio surface-mount antenna with 3' antenna cable
SR-YAGI-6	Spread Spectrum Radio directional Yagi antenna operating at 6 dBi. Does not include antenna cable
SR-YAGI-9	Spread Spectrum Radio directional high-gain Yagi antenna operating at 9 dBi. Does not include antenna cable
SR-FILTER	Spread Spectrum Radio frequency filter
WEN-STUBBY	Wi-Fi surface-mount antenna with 3' antenna cable
WEN-YAGI-11	Wi-Fi high-gain directional Yagi antenna operating at 11 dBi. Does not include antenna cable
LMR-195-DB	Antenna cable with end connectors. Available in 10', 20', 30' 40' and 50' lengths (e.g., LMR-195-DB-10ft). Special-order custom lengths available. Maximum length 100'
LMR-400-DB	Antenna cable with end connectors. Available in 10', 20', 30', 40', and 50' lengths (e.g., LMR-400-DB-10ft). Special-order custom lengths available. Maximum length 100'
LMR-600-DB	Antenna cable with end connectors for cable lengths greater than 100'. Special-order custom lengths only
ANT-PROT	Antenna cable surge protection device
ANT-SOM	3' antenna stand-off mount for 3" maximum tower leg
ANT-TRIP5	Non-penetrating antenna tripod mount – 5' high
SR-FILTER	Spread Spectrum Radio frequency filter
STICK-MNT-BRKT	Stick antenna mounting bracket
YAGI-MNT-BRKT	Yagi mounting bracket

LR Radio antennas are offered for sites with existing LR Radio setups and in limited circumstances. For more information, check with your [Calsense representative](#).

Data Access Service Plans

Part #	Description

COMM-1YR-2	One-year prepaid data access service plan for one cellular modem communicating with one or two controllers (billed annually)
COMM-1YR-4	One-year prepaid data plan for one cellular modem communicating with three or four controllers (billed annually).
COMM-1YR-35	One-year prepaid data plan for one cellular modem communicating with 5 to 35-controllers (billed annually)
COMM-1YR-36+	One-year prepaid data plan for one cellular modem communicating with 36 or more controllers (billed annually).
COMM-5YR-2	Five-year prepaid data access service plan for one cellular modem communicating with one or two controllers (billed every five years)
COMM-5YR-4	Five-year prepaid data plan for one cellular modem communicating with three or four controllers (billed every five years)
COMM-5YR-35	Five-year prepaid data plan for one cellular modem communicating with 5 to 35-controllers (billed every five years).
COMM-5YR-36+	Five-year prepaid data plan for one cellular modem communicating with 36 or more controllers (billed every five years)
COMM-10YR-2	10-year data plan for one existing GR modem communicating with one or two controllers. Noncancellable and nonrefundable
COMM-10YR-4	10-year data plan for one existing GR modem communicating with three or four controllers. Noncancellable and nonrefundable
COMM-10YR-35	10-year data plan for one existing GR modem communicating with 5 to 35 controllers. Noncancellable and nonrefundable
COMM-1YR-RR	1-year prepaid data plan for CS3000 remote (billed annually). No voice or text messaging included. Provides access to Calsense irrigation controllers and Command Center Online only. Non-cancellable and non-refundable. If renewing an existing plan, existing phone number required
COMM-5YR-RR	5-year prepaid data plan for CS3000 remote (billed every five years). No voice or text messaging included. Provides access to Calsense irrigation controllers and Command Center Online only. Non-cancellable and non-refundable. If renewing an existing plan, existing phone number required

Cellular Devices with Data Bundles

Part #	Description
CS3-LR-TO-GR-BNDL-LIFE	Trade-in for existing LR users only. 4G LTE cellular modem for CS3000 to provide communication with cloud-based Command Center Online web application. Includes GR-STUBBY antenna and prepaid data plan for 1-cellular modem communicating with 1 controller, for the life of the modem. Non-cancellable and non-refundable. Must include customer/job location.
CS3-GR-BUNDLE-2	4G LTE cellular modem for a CS3000 for communication with the Command Center Online web application. Includes GR-STUBBY antenna and a prepaid 10-year data plan for one cellular modem communicating with one or two controllers. Non-cancellable and non-refundable
CS3-GR-BUNDLE-4	4G LTE cellular modem for a CS3000 for communication with the Command Center Online web application. Includes GR-STUBBY antenna and prepaid 10-year data plan for one cellular modem communicating with three or four controllers. Non-cancellable and non-refundable

CS3-GR-BUNDLE-35	4G LTE cellular modem for a CS3000 for communication with the Command Center Online web application. Includes GR-STUBBY antenna and prepaid 10-year data plan for one cellular modem communicating with five to 35 controllers. Non-cancellable and non-refundable.

Irrigation Controller

CS3000

The Calsense CS3000 irrigation controller is an impactful, EPA WaterSense-certified water conservation and management tool. Its major features include flow monitoring and management and weather-based irrigation, which uses daily evapotranspiration (ET) to calculate station run times based on landscape details such as soil makeup, slope, plant material, head type, and sun exposure.

The CS3000 provides a wide range of programming flexibility, including:

- Unlimited programs that can water individual stations or multiple interspersed stations to maximize system capacity and reduce watering time.
- Ability to assign landscape details, such as plant material, head type, and sun exposure to groups of stations to simplify programming for stations with similar characteristics.
- Support for managing flow on up to four mainlines and 12 points of connection simultaneously when sharing flow with multiple controllers.
- Automatic cycle and soak scheduling to water each station for a fixed cycle time and allow water to soak in between cycles to maximize water saturation and minimize runoff.
- Ability to accommodate multiple irrigation schedule types, including irrigating on even days, odd days, prescribed days of the week, and/or interval scheduling, ranging from every other day up to every four weeks.
- Predictive water budgeting features to maximize savings during drought conditions and times of watering mandates.
- Always connected controllers using an Internet of Things (IoT) architecture for irrigation management through phones, tablets, and laptops, regardless of location or time.
- Manual programs that allow users to schedule stations to run for a preset time, up to six times per day, for hydro-seeding and new planting.
- Electrical alerts for issues, including short circuits and no currents, to help technicians troubleshoot field wiring and solenoid problems.
- Permanent memory to store all controller programming and setup data, including date and time, in a non-erasable format.
- Availability in multiple station counts including 8, 16, 24, 32, 40, and 48 stations. If less than 48 stations are purchased initially, additional stations can be added at any time.
- Supports up to 128-stations when using 2-Wire. This can either be 128 2-Wire stations (max 70 decoders), or when combined with conventionally wired stations, up to 80 2-Wire stations and up to 48 conventionally wired stations.
- Backplane that supports field-replaceable modules, such as terminal strips for field wire connections, 2-Wire cable, and Calsense accessories, like an ET gage and/or tipping rain bucket.
- Reports detailing various data available on-demand at the controller and in the Command Center Online web application, including Alerts, Station History, On-at-a-Time, Water Usage, Water Management, Station Summary, POC Summary, Mainline Summary, Moisture Sensors and Controller Details.

Central Control

Command Center Online

Calsense Command Center Online is a cloud-based package designed to provide easy and complete irrigation control for all CS3000 controllers. It enables the user to turn on up to six valves simultaneously from any Internet-connected device. Daily weather data can be automatically shared with controllers from WeatherSense, tipping rain buckets, and/or external weather sensors. Based on the real-time data received, controllers adjust station run times to help manage water and labor costs.

The user can access several reports from Internet-connected devices, including PCs, tablets, and smart phones. The Daily Alerts Report displays flow and electrical issues alongside their locations and causes, and system reports include records for every irrigation cycle: water usage versus water budget, gallons and percentages of water saved, and events and changes that occurred at the controller. Reports are also available for a variety of other metrics. See page 13 for a list of some of the reports available with Command Center Online.

Each customer's service is password protected, so data is secure. User accounts are issued and managed by an administrator account, and only authorized users can access controller information. System administrators receive regular reports for sites and users. The application can be connected to controllers through a variety of options, including Ethernet, Wireless Ethernet (Wi-Fi), and cellular modems. Calsense provides several options for communication between controllers and with Command Center Online, detailed in Communication Options on page 37.

Calsense also offers a mobile version of Command Center Online to facilitate onsite work and allow users to perform tasks from their mobile devices. The application displays flow activity and weather data from onsite rain buckets and ET gages.

Minimum System Requirements

- A broadband Internet connection, such as DSL, cable, or mobile broadband
- Any modern web browser

Enclosures

Wall-Mount Enclosure (model WM, WM1, and WM2)

The Calsense Wall-Mounted Enclosure is a fully assembled unit with a Calsense controller (**Error! Reference source not found.**). The 16.25" x 14.5" x 7.375" box is made with weather- and vandal-resistant, powder-coated stainless steel, includes transient and lightning protection, and comes with factory-labeled terminals. It features a security-tight locking mechanism, louvered vents with splash guards, and insect screens. The -WM1 and -WM2 options include radio antenna holes for controllers with a cellular device Wireless Ethernet (Wi-Fi), or Spread Spectrum Radio. All Wall-Mounted Gray Boxes come with 10-year warranties and are UL-approved.
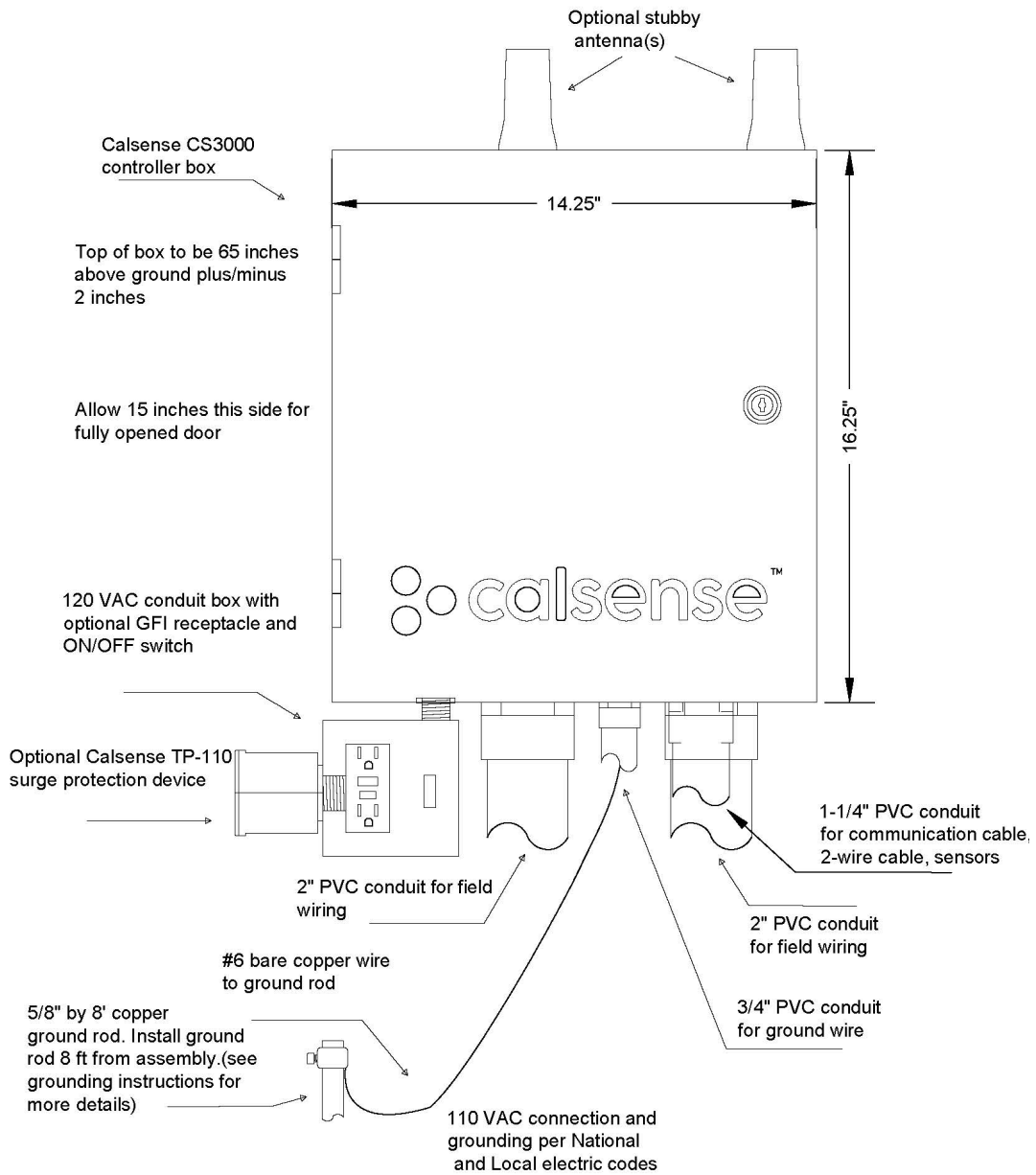

Figure 1 - Wall-Mount enclosure installation detail

Installation

When choosing a location for the controller, all power wires must be accessible, and routing to irrigation remote control valves must be carefully planned. Calsense recommends wires from the 120-VAC (VAC) supply have a disconnect switch. The controller must have at least two inches of clearance above it for the door to be removed after installation. Additionally, the door needs at least 15-inches on the left to fully open. Wall mounted controllers must be secured to the provided mounting template on a flat surface, and, for best viewing, the liquid crystal display (LCD) should be at eye level for users.

Heavy-Duty Stainless–Steel Enclosure (model S, S1, and S2)

The Heavy-Duty Stainless-Steel Enclosure (SSE) is a fully assembled pedestal unit with a Calsense controller (**Error! Reference source not found.**). The controller is mounted at a 25° angle for access and viewing. The 37.875" x 14.5" x 13.325" enclosure is made with weather- and vandal-resistant stainless steel, includes transient and lightning protection, and comes with factory-labeled terminals, a GFI outlet, and a toggle switch. The unit also features a security-tight locking mechanism, louvered vents with splash guards, and insect screens. The S1 and S2 options include radio antenna holes for controllers with a cellular modem, Wireless Ethernet (Wi-Fi), or Spread Spectrum Radio. All SSE enclosures come with 10-year warranties and are UL-approved.
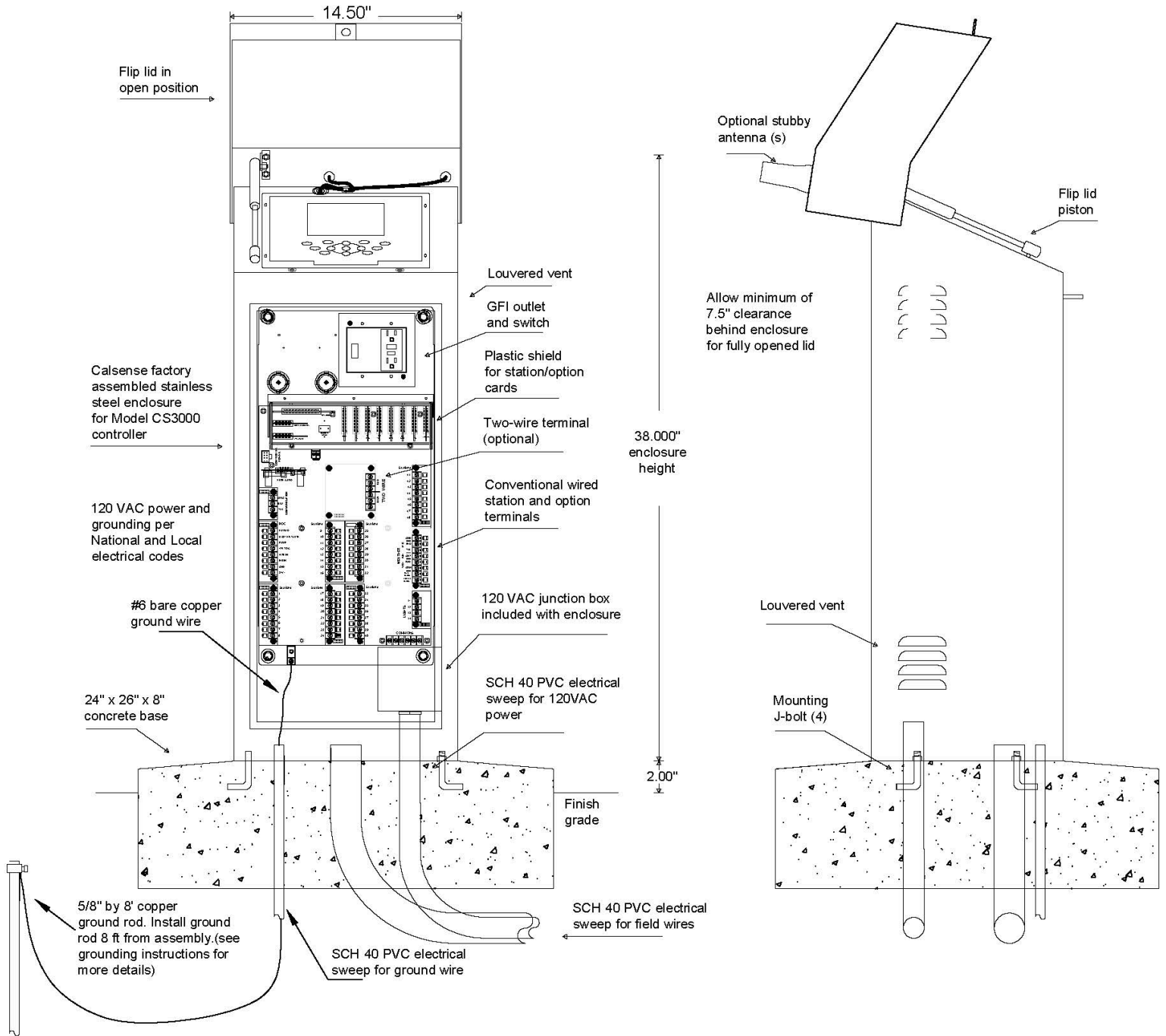
14.50"

Flip lid in open position

Louvered vent

GFI outlet and switch

Calsense factory assembled stainless steel enclosure for Model CS3000 controller

Plastic shield for station/option cards

Two-wire terminal (optional)

38.000" enclosure height

120 VAC power and grounding per National and Local electrical codes

Conventional wired station and option terminals

#6 bare copper ground wire

120 VAC junction box included with enclosure

24" x 26" x 8" concrete base

SCH 40 PVC electrical sweep for 120VAC power

Finish grade

2.00"

5/8" by 8' copper ground rod. Install ground rod 8 ft from assembly.(see grounding instructions for more details)

SCH 40 PVC electrical sweep for ground wire

SCH 40 PVC electrical sweep for field wires

Optional stubby antenna (s)

Flip lid piston

Allow minimum of 7.5" clearance behind enclosure for fully opened lid

Louvered vent

Mounting J-bolt (4)

Figure 2 - Stainless steel enclosure installation detail

Installation

When choosing a location for the CS3000 controller, all power wires must be accessible, and routing to irrigation remote control valves must be carefully planned. Pedestal enclosures require at least seven inches of space behind them to fully open the lid and must be mounted on a level, 12.5" x 18.5" x 8" concrete base. The top of the base must be at least two inches above the finish grade. Each model comes with four anchor bolts for securing the pedestal to the concrete and a mounting template for positioning the anchor bolts. The anchor

bolts must be positioned in the concrete before it sets, and the mounting template must be removed prior to installing the pedestal.

Pedestal controllers come with a switch for supplying power to the controller. Sweep ells for irrigation control wires should be on the right and the sweep ell for the 120-VAC wires should be on the left. All sweep ells should be positioned in the concrete form. For more information on electrical installation and grounding, see Standard Electrical on page 20.

> Note: Allow at least five inches between the outside edges of the mounting templates when mounting more than one controller on the same base.

Heavy-Duty Double-Wide Stainless–Steel Enclosure (model SD, SD1, SD2, SD3)

The Double-Wide Heavy-Duty Stainless-Steel Enclosure (SD) is a fully assembled unit with a combination of any two Calsense CS3000 Irrigation Controllers (**Error! Reference source not found.**). The unit is 37.875" x 26.5" x 13.325". The Double-Wide Enclosure can include two CS3000 conventional controllers with up to 48 stations each (model CS3-xx-SD), two CS3000 2-wire controllers (model CS3-2W-SD), or one conventional 8-station controller and one 2-wire controller (model CS3-8-2W-SD). Station kits offer further expansion.

The enclosure is made with weather- and vandal-resistant stainless steel, includes transient and lightning protection, and comes with factory-labeled terminals, a GFI outlet, and a toggle switch. It also features a security-tight locking mechanism, louvered vents with splash guards, and insect screens. The D1 and D2 models include radio antenna holes for controllers with a cellular modem, Wireless Ethernet (Wi-Fi), or Spread Spectrum Radio. All Double-Wide SSE enclosures come with 10-year warranties and are UL-approved.

Installation

When choosing a location for the CS3000 controller, all power wires must be accessible, and routing to irrigation remote control valves must be carefully planned. Pedestal enclosures require at least 7.5 inches of space behind them to fully open the lid and must be mounted on a level, 38" x 24" x 8" concrete base. The top of the base must be at least two inches above the finish grade. Each model comes with anchor bolts for securing the pedestal to the concrete and a mounting template for positioning the anchor bolts. The anchor bolts must be positioned in the concrete before it sets, and the mounting template must be removed prior to installing the pedestal.
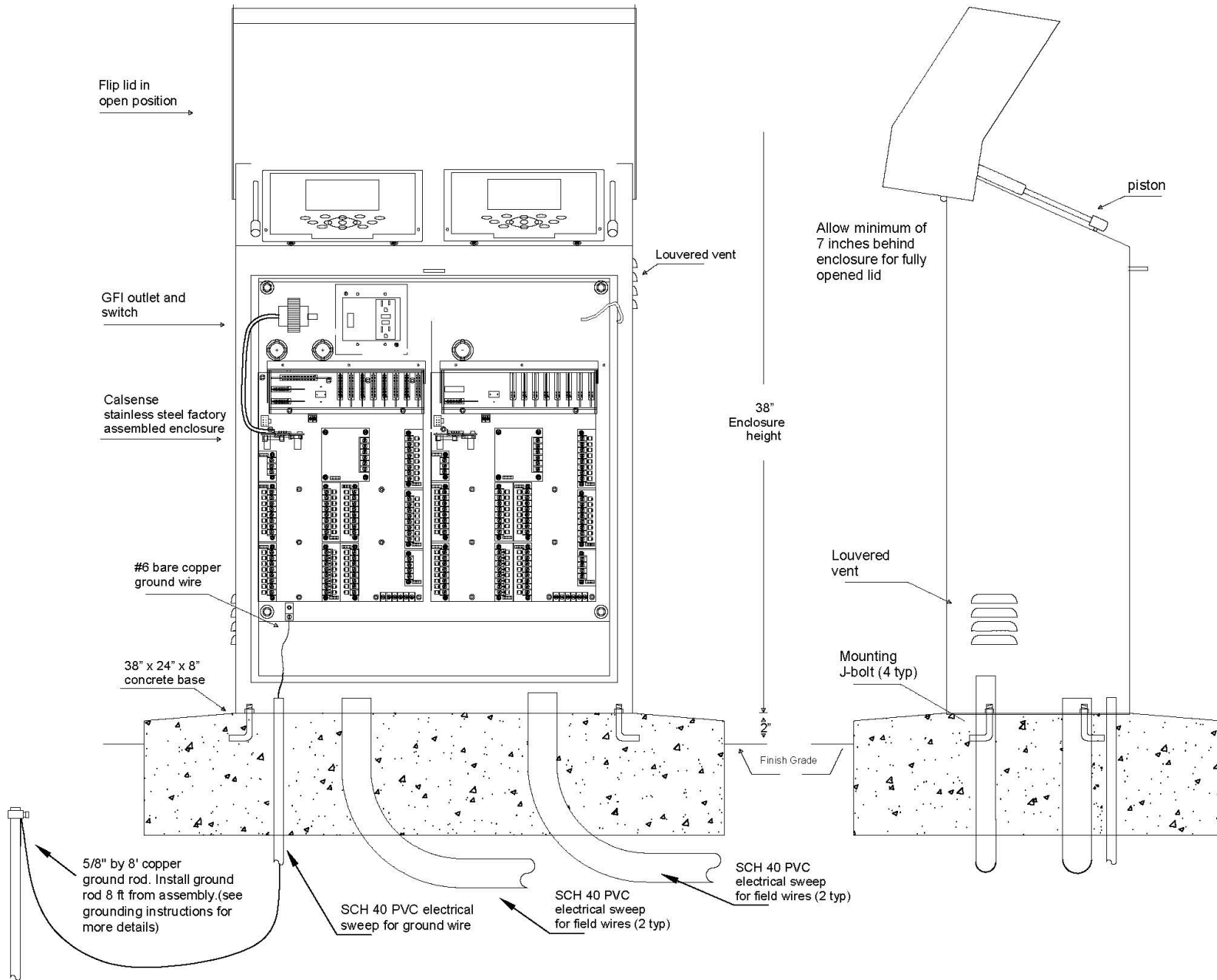
Figure 3 - Double-wide stainless-steel enclosure installation detail

Pedestal controllers come with a switch for supplying power to the controller. Sweep ells for irrigation control wires should be on the right side of each controller and sweep ells for the 120-VAC wires should be on the left. All sweep ells should be positioned in the concrete form. For more information on electrical installation, see Standard Electrical on page 20.

Standard Electrical

Calsense CS3000 controllers are supplied by low voltage (24-volt AC) step-down transformers. Field valve wires are connected to factory-labeled terminals, and field common wires are connected to the CS3000 controller commons.

Specifications

- UL-approved

  > Note: If additional holes are created in the enclosure, the UL listing will be considered void.

- Input: 120-VAC, 60-Hz, 1.0A (input - 120-VAC power lines connected to the input wires of the transformer)
- 56-VA transformer (output - Class 2, rated 24-VAC, maximum 2.0A total load)
- 24-VAC output to valves
- 24-VAC output to master valve
- 24-VAC output for use with pump start relay
- Electrical surge protection

Electrical Hook-up

All 120-VAC electrical and grounding hook-ups should be installed per local codes and National Electric Code. For Wall-Mount controllers (model -WM), the 120-VAC power line should be enclosed in a conduit approved for grounding and connected securely to the transformer nipple. The Stainless-Steel and Double-Wide enclosures include a prewired conduit with a junction box on the back. Connections to an outgoing conduit must be made inside the conduit box.

The transformer supplies power to simultaneously operate six 0.25-amp (A) solenoids or a master valve or pump start relay with five 0.25A solenoids. When using 2-wire, up to six solenoids on a 2-Wire path can be energized at once.

> Note: Any single output may be loaded to 1.5A, but the total load of all outputs cannot exceed 2.0A.

Heavy-Duty Double-Wide Stainless Steel Solar Enclosure (model SL)

The CS3-8-SL and CS3-2W-SL units are housed in a UL-approved flip-top enclosure with a Calsense CS3000 irrigation controller on the left and a solar controller and charger equipment on the right (**Error! Reference source not found.**). The unit includes a solar panel, power inverter, power monitor, batteries, and circuit breakers. The CS3-8-SL comes pre-assembled and pre-wired. The CS3-8-SL is compatible with conventional controllers with up to 48 stations, while the CS3-2W-SL works with 2-Wire. Both can communicate back to the cloud application using a CS3-GR-KIT communication option.

The CS3-SL eliminates the need for a power source near the controller and minimizes lifetime maintenance needs through maximizing battery charge and health automatically. The controller is mounted at a 25° angle for easy access, viewing, and programming. The self-sustaining efficiency of the solar kit makes it the most environmentally friendly irrigation controller on the market, and it can easily be integrated with an existing Calsense system.
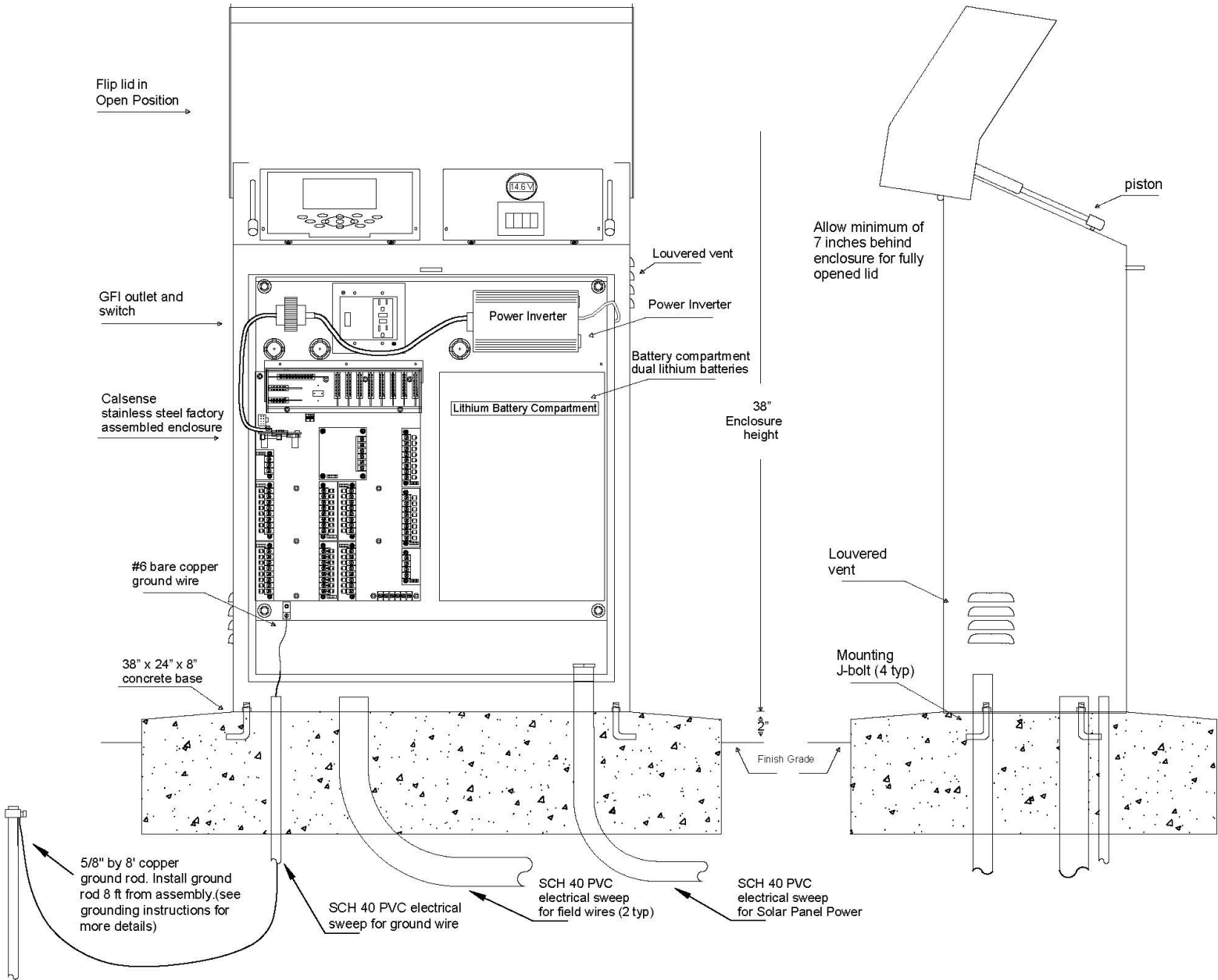
Figure 4 - Solar enclosure installation detail

Installation

When choosing a location for the CS3000 controller, all power wires must be accessible, remote control valves must be carefully planned. Solar enclosures require at least seven inches of space behind them to fully open the lid and must be mounted on a level, 38" x 24" x 8" concrete base. The top of the base must be at least two inches above the finish grade. Each model comes with anchor bolts for securing the pedestal to the concrete and a mounting template for positioning the anchor bolts. The anchor bolts must be positioned in the concrete before it sets, and the mounting template must be removed prior to installing the pedestal.

Electrical (Solar Only)

The CS3000 solar enclosure includes a solar panel that supplies power to the controller and charges two batteries used to power the controller at times with insufficient sunlight. The solar panel must be installed no more than 30 feet (60 feet with a splice) from the controller and be mounted in a 36" x 48" concrete form (Figure 5). The panel must be angled to receive maximum sun exposure throughout the year (typically southwest) and be free of obstructions that may cause shading. The length of the solar panel wires from the top of the panel to the assembly hookup must be no more than 60 feet when using the included wire and 90 feet for custom length solar panels. The solar panel comes with a 10-gauge grounding cable to be routed through the solar pole and terminated with a ground rod or plate.

Specifications include:

- Two 12.8V batteries
- 200W Solar Panel
- DC miniature circuit breakers
- Smart Bluetooth Monitor
- Inverter with 210-245V output (DC/AC inverter, 120-VAC output to controller)
- Charge Controller (75/10, 75/15, 100/15, 100/20 & 100/20-48V)
- 24-VAC output to valves, including master valve and for use with pump start relay
- Electrical surge protection
- Solar components are <u>not</u> UL approved

Note: Designers must verify that a site will receive sufficient sunlight to power the controller assembly based on available sunlight at the panel location and duration of light exposure throughout the year.
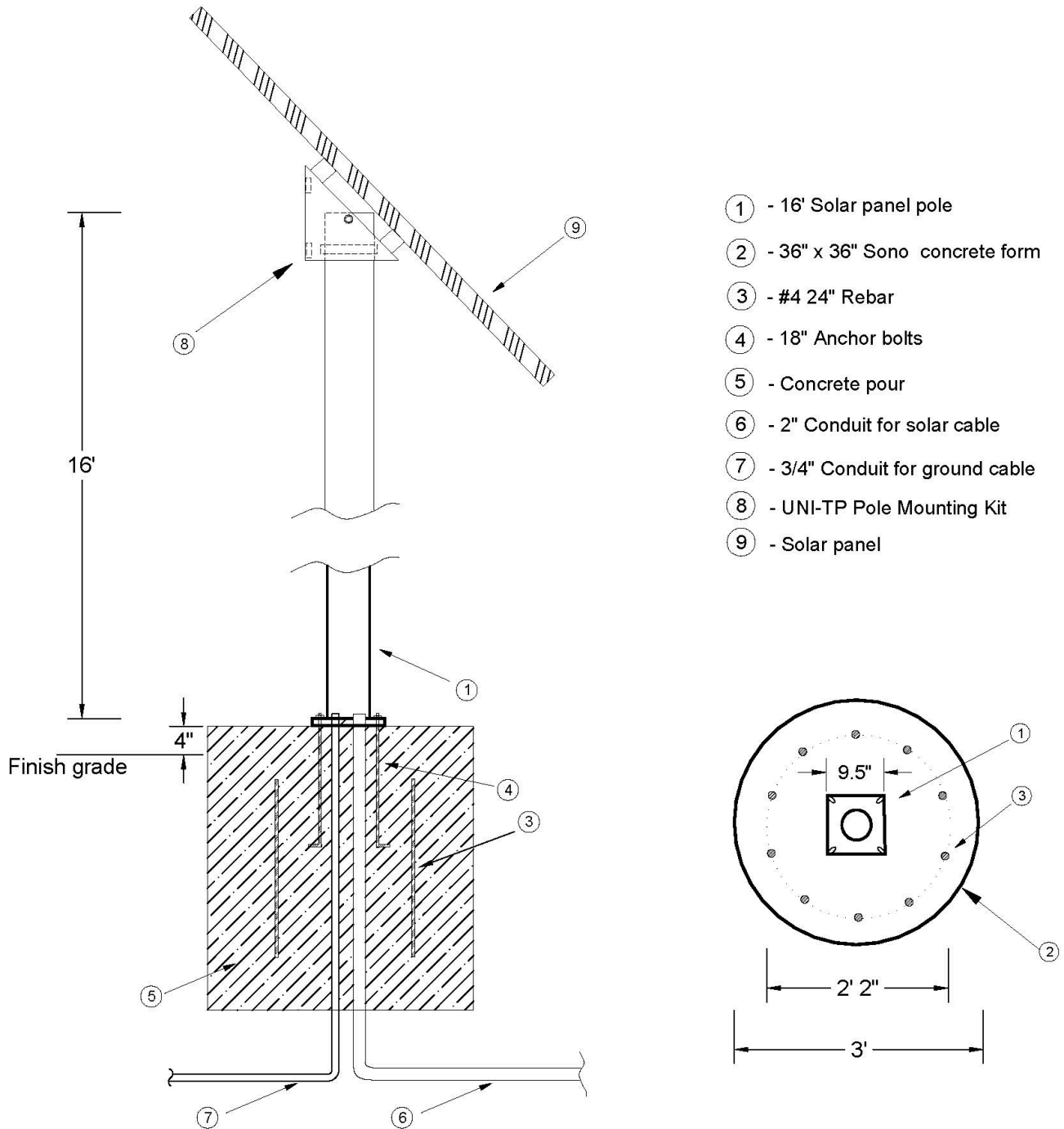
1 - 16' Solar panel pole

2 - 36" x 36" Sono concrete form

3 - #4 24" Rebar

4 - 18" Anchor bolts

5 - Concrete pour

6 - 2" Conduit for solar cable

7 - 3/4" Conduit for ground cable

8 - UNI-TP Pole Mounting Kit

9 - Solar panel

Figure 5 - Solar panel installation detail

Transient Protection

The Calsense CS3000 backplane offers transient protection on each field-replaceable module to prevent transient surges from the field from entering the CS3000 controller (**Error! Reference source not found.**). Lightning strikes can cause considerable damage to irrigation equipment. The backplane protects against this by using transorbs - solid-state devices that direct incoming transient to a ground rod and away from the controller.
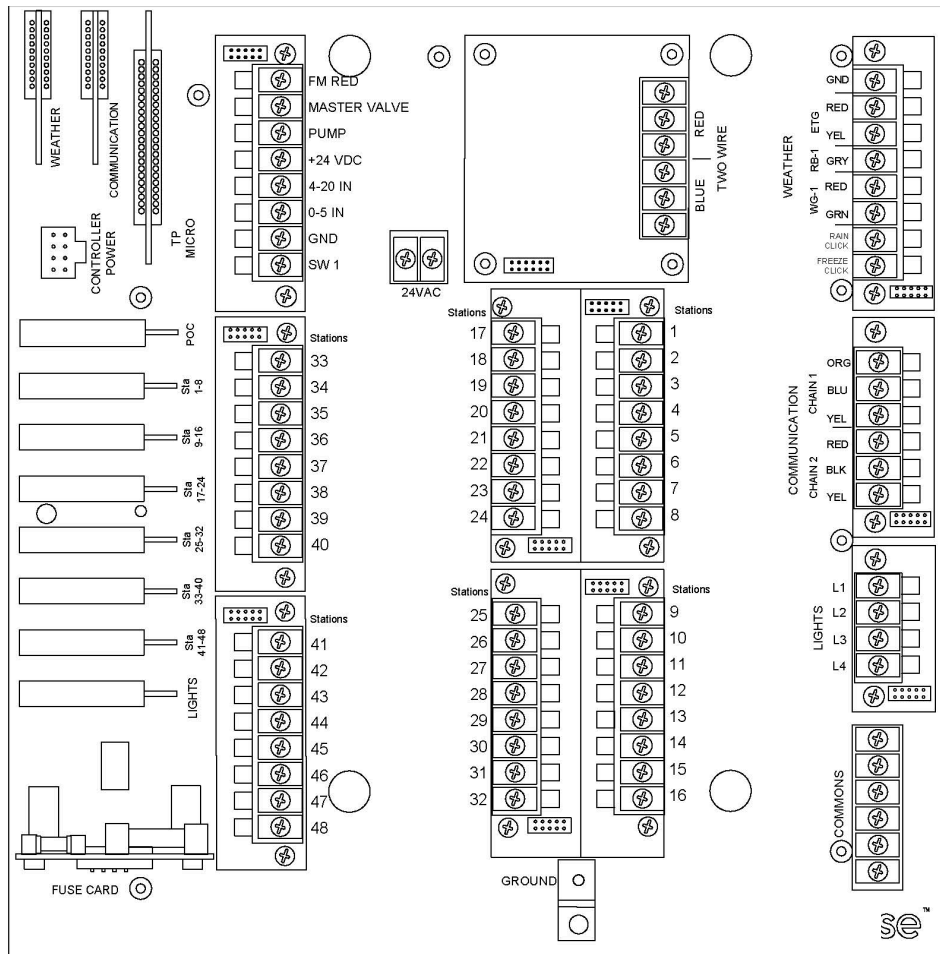
Figure 6 - CS3000 Wall-mount backplane detail

Grounding Instructions

Each irrigation controller requires a 5/8-inch by 8-foot copper ground rod or equivalent ground plate installed at least 8 feet from the controller and other electronics. Wall-Mount controllers installed side-by-side may share a ground rod/plate if they share an electrical branch supply circuit. Ground rods/plates should be connected to the controller's ground lug using #6 AWG solid copper wire (not braided) with minimal bending. If the wire must be bent, the radius should be greater than 8 inches. The connection to the ground rod/plate should be installed inside a 10-inch round valve box or, if a pedestal is mounted, through the pedestal base. The connection to the ground rod/plate must be welded or brazed. The ground rod/plate must NOT be shortened.

Wall-mount controllers have an opening for PVC conduit to route grounding wire through the bottom of the controller. Pedestal controllers require grounding through a sweep ell in the concrete base. In a 2-Wire system,

CAUTION: Never connect the ground rod or field common to FM Red on the POC Terminal strip. This will disable the over-current protection and could result in damage to the controller. See ground rod manufacturer's information for details and requirements for your grounding device.

> **Note:** The solar panel included with the solar enclosure requires a separate ground rod or ground plate from the controller. The included grounding cable must travel through the solar pole and terminate at the ground rod or plate.

Lightning Warranty

The standard warranty covers lightning damage if the controller and each item within are installed in accordance with Calsense's installation instructions, grounding instructions, local codes, and National Electric Code.

2-Wire

2-Wire Option (model CS3-2WIRE-OPT)

Unlike conventional irrigation systems, 2-Wire systems have two wires that connect the controller to various stations in the system through a series of decoders. The same two wires run underground and send power and signals to each decoder along their path(s). The signals tell each station decoder to turn on its corresponding stations through activating their solenoids. As a result, solenoids do not each require a separate power wire.

Decoders are electronic devices connected to the 2-Wire path. They operate irrigation devices based on signals received from the controller through the wire path. There are three types of decoders: POC (point of connection), station, and soil moisture sensing. One controller can have up to 80 total decoders (70 station decoders and additional POC or Soil Moisture Sensor decoders) across 128 total stations. Each decoder has its own serial number, used to identify it in the system. Decoders are assigned using their serial numbers.

The 2-Wire option includes outputs for up to 12 master valves and flow sensors per *FLOWSENSE®* chain.

Installation Guidelines

2-wire decoders connect to a 2-wire cable (Regency's Hunter Decoder Cable or Paige P7354D) that runs from the irrigation controller. The total length of 2-Wire cable per controller should be no more than 7,000 feet. A single decoder can operate up to two valves. The 2-Wire path must have a 5/8-inch x 8-foot copper ground rod or ground plate every 300 feet (or at the next closest decoder) and at the end of each path. Ground rods/plates must be at least 8 feet from the 2-Wire path.

Electronic signals are sent between the decoders and the controller for communication, so all connections must be waterproof. Calsense recommends using 3M Scotchcast 3570G Connector Sealing Packs (formerly 3M Scotchlok 3570 Connector Sealing Packs) for all electrical connections, including splices along the 2-wire path. If 3M Scotchcast 3570G sealing packs are not available, 3M DBR/Y-6 Direct Bury Splice Kits may be substituted.

If wire splices are unavoidable, they must be installed in a valve box using 3M Scotchcast 3570G Connector Sealing Packs (formerly 3M Scotchlok 3570 Connector Sealing Packs), Spears DS 100 Dri- Splice Connectors with DS-300 Dri-Splice Sealant, or 3M DBR/Y-6 Direct Bury Splice Kits.

2-Wire 2-Station Decoder (model CS-2W-2ST)

The 2-Wire 2-Station operates up to two solenoids using a different-colored wire for each (Figure 7). A single controller can operate up to 128 valves spread across a maximum of 70 physical 2-Wire 2-Station Decoders. All wire runs between valves and decoders should be direct pulls (no splices), except at the decoder location.

2-wire decoders use #14 AWG direct burial wire to connect to remote control valves. The wire runs between the decoder and the valve can be up to 100 feet.
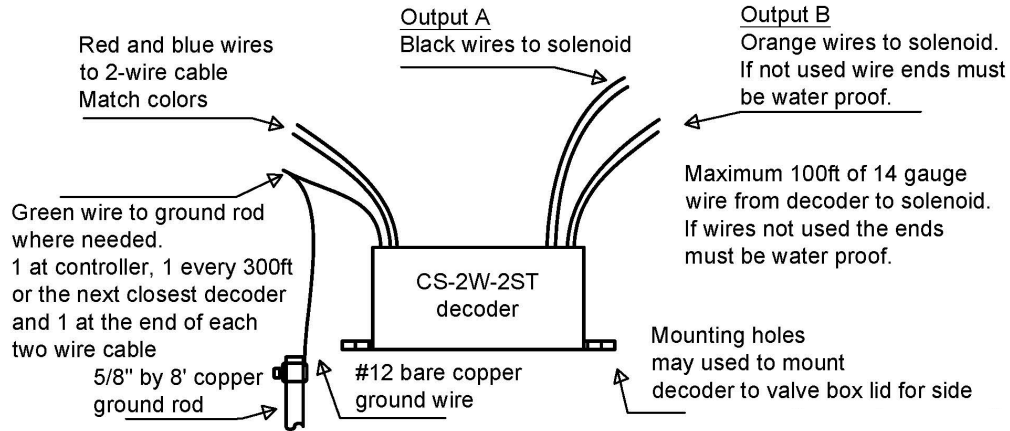
Figure 7 - 2-Wire 2-Station decoder installation detail

2-Wire POC Decoder (model CS-2W-POC)

The POC decoder operates a single master valve and flow meter (Figure 8). A single controller can operate up to six POC decoders. Using *FLOWSENSE*, a system can have a chain of up to 12 controllers, with a total of 12 points of connections distributed amongst the controllers. All wire runs between valves and 2-Wire decoders should be direct pulls (no splices), except at the decoder location.
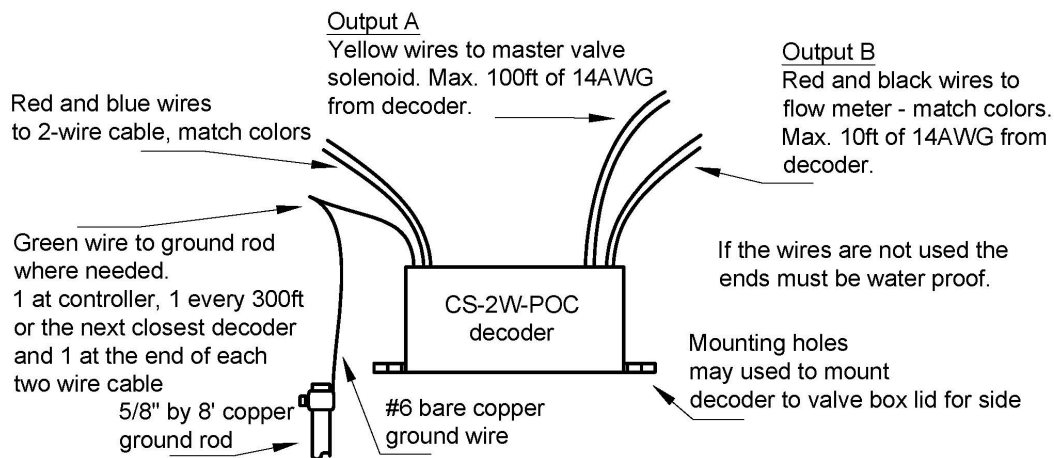

Figure 8 - 2-Wire POC decoder installation detail

2-wire decoders use #14 AWG direct burial wire to connect to remote control valves. The wire run from the decoder to the Flow Meter can be up to 10 feet, and the wire run from the decoder to the master valve can be up to 100 feet.

2-Wire Soil Moisture Sensor Decoder (model CS-2W-MOIST)

The Calsense Soil Moisture Sensor accurately measures the volumetric water content at the depth at which the sensor is placed by measuring the dielectric constant of the soil with capacitance/frequency domain technology. It provides information helpful in managing the amount of water applied to maintain soil water balance for optimum plant growth.

The 2-Wire Soil Moisture Sensor Decoder is used with the 2-Wire Option (model CS3-2WIRE-OPT). The dual sensor comes with a 16-foot cable and the ability to wire one remote control valve to the 2-Wire cable. Moisture sensors can be installed anywhere along the 2-Wire path.

The user can assign a moisture sensor at a given location to a Station Group, which may encompass stations in several locations with similar characteristics. The CS3000 compares the sensor reading at the beginning of each irrigation cycle to the user defined set point to determine when to stop irrigation.

Flow Meters

Calsense flow meters enable CS3000 irrigation controllers to measure the flow rate of an irrigation system – a key metric in reporting water use and detecting mainline breaks, broken risers, and closed or stuck valves. The meter is installed in the mainline after the water meter or backflow preventer. The flow meter can be installed on either side of the master valve, and the master valve may be normally open or normally closed.

The correct flow meter size depends on the station's flow rates and permissible pressure loss through the flow meter. Therefore, when installing a flow meter, the mainline pipe is typically sized down to accommodate the fitting of the flow meter. See Flow Meter Sizes and Permissible Pressure Loss for more information. Additionally, the length of free, unrestricted pipe upstream of the flow meter must be at least ten times the flow meter size, and the length downstream must be at least five times the flow meter size.

The arrow on top of the flow meter indicates the intended direction of the flow. The flow meter should be easily accessible and housed in a rectangular valve box marked 'FM.' Installation should allow for clean and easy access to the unit.

For more information on flow meter options and help determining the best use of flow meters at a given site, contact your Calsense representative.

Tee-Type Flow Meter (model FM)

The Tee-Type Flow Meter is available in pipe sizes between 1.5 and 3 inches in diameter and comes in brass or PVC (Figure 9). The CS3000 controller is pre-programmed with all the settings to operate a Calsense Tee-Type Flow Meter out of the box. The brass models are rated for operation in temperatures up to 150 °F, and the PVC models are rated for operation in temperatures of 35 to 110 °F.
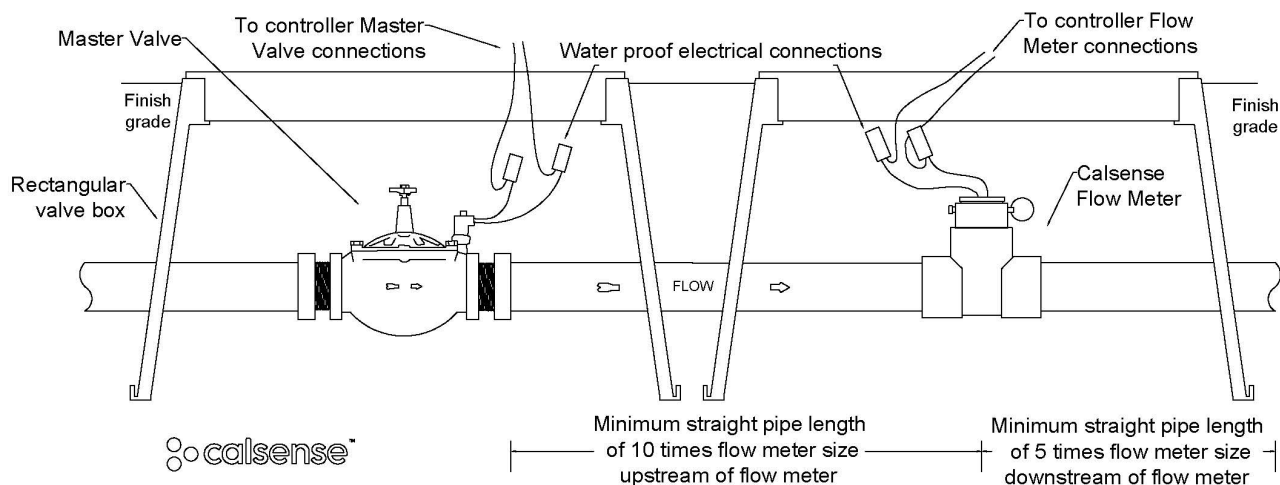

Figure 9 - Tee-type flow meter installation detail

Ultrasonic Flow Meter

The Ultrasonic Flow Meter is available in pipe sizes between 1 and 4 inches and a saddle-style in sizes between 6 and 12 inches. It is available with a PVC tee or as an "insert retrofit" for replacement of existing paddlewheel flow sensors.

Insert-Type Flow Meter (model FMBX)

The Insert-Type Flow Meter is available in pipe sizes between 3 and 18 inches (Figure 10). It is mounted to the pipe with a pipe saddle or welded-on threaded fitting (not included). It is made of brass and bronze hardware and comes with a bronze 2-inch NPT externally threaded hex adapter for mounting.
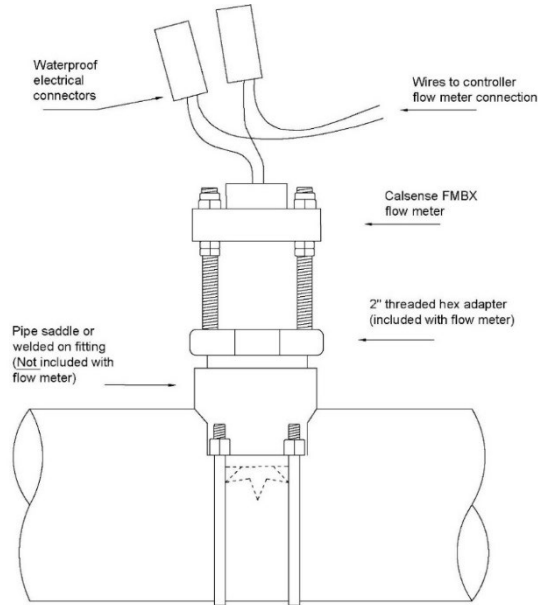

Figure 10 - Insert-type flow meter installation detail

Third-Party Hydrometers

The Calsense CS3000 includes support for various hydrometers including Electronic Register and Photodiode Register hydrometers from Netafim, BERMAD, and ARAD, as well as Reed Switch register hydrometers. For the Reed Switch registers, Calsense supports hydrometers between 1.5 and 10 inches with 1-pulse per 1-gallon and 1-pulse per 10-gallon switches.

Note: 2-wire paths do not currently support hydrometers. Hydrometers must be wired to the POC terminal on the controller.

Flow Meter Sizes

Calsense flow meters are available in a variety of models for different pipe sizes and water pressures.

Flow Meter Size (in.)	Minimum Upstream Pipe Length (in.)	Minimum Downstream Pipe Length (in.)	Pipe Diameter (in.)
1	10	5	1
1.25	12.5	6.25	1.25
1.5	15	7.5	1.5
2	20	10	2
3	30	15	3
4	40	20	4
6	60	30	6
8	80	40	8
10	100	50	10
12	120	60	12

Table 1 - Flow meter sizing chart

The correct flow meter size depends on the station flow rates and permissible pressure loss through the flow meter, NOT the size of the irrigation mainline. The system's maximum flow rate should be the highest reading on the flow meter, and the minimum flow rate should be the lowest measurable flow rate on the flow meter. If the flow rate is less than the minimum, the flow reading for the station will be inconsistent and may result in a no-flow alert when the station irrigates.

To determine the correct flow meter size for an irrigation system, follow these steps:

1. Determine the station with the highest flow rate on the system.
2. Determine the station with the lowest flow rate on the system.
3. Make sure that both flow rates are within the operating range of the selected flow meter size in Table 2.
4. For systems with a large mainline or with significant variance between high and low flows, consider using multiple flow meters as a bypass manifold to read both high and low flowing valves. See Bypass Manifold on page 33 for more information.

| Model | Min Flow (0.5 fps) | Recommended Range* | | Max Flow (15 fps) | PSI Loss @ gpm |
		Min Flow (1 fps)	Max Flow (15 fps)		
FM 1.5	5 GPM	7 GPM	105 GPM	100 GPM	0.5 PSI @ 96 GPM
FM 2	10 GPM	11 GPM	166 GPM	200 GPM	0.5 PSI @ 165 GPM
FM 2B	6 GPM	11 GPM	166 GPM	166 GPM	0.5 PSI @ 165 GPM
FM 3	20 GPM	24 GPM	363 GPM	300 GPM	0.5 PSI @ 390 GPM
Model	Min Flow (0.1 fps)	Min Flow (1 fps)	Max Flow (15 fps)	Max Flow (30 fps)	PSI Loss @ gpm
FM 1B	2 GPM	3 GPM	50 GPM	50 GPM	0.5 PSI @ 36 GPM
FM 1.25B	3 GPM	5 GPM	81 GPM	81 GPM	0.5 PSI @ 69 GPM
FM 1.5B	4 GPM	7 GPM	106 GPM	105 GPM	0.5 PSI @ 96 GPM

Flow in the recommended range typically produces readings within 1% of actual flow

Model	Min Flow (0.1 fps)	Max Flow (15 fps)
FM 1U	0.22 GPM	33 GPM
FM 1.5 U	0.55 GPM	82 GPM
FM 2U	0.92 GPM	138 GPM
FM 3U	2.06 GPM	309 GPM
FM 4U	3.58 GPM	537 GPM
FM 6U	9 GPM	1350 GPM
FM 8U	15 GPM	2300 GPM
FM 10U	24 GPM	3650 GPM
FM 12U	35 GPM	5300 GPM

Table 2 - Flow meter operating ranges

Operation

Flow meters use a sensing device to measure flow in gallons per minute (GPM). Upon installation, the user sets up the controller to acquire expected flow rates of the stations throughout the system. In subsequent irrigation cycles, the system can then identify and address a variety of issues through comparing the expected and actual flow rate. User set parameters can direct the controller to take certain actions based on the expected versus actual flow rate. For example, a broken head or riser triggers a high flow alert, shuts off the affected station, and turns on the next station. An alert is displayed on the station's programming screen, the Alerts Report, and within Command Center Online. Similarly, if a remote-control valve does not open, is obstructed, or has a measured rate less than the flow meter minimum, the controller will display a low flow alert. If the backflow preventer or water meter has been turned down or off, every station on the controller indicates this alert. The system will continue to display alerts and take corrective action until the issue is resolved.

When used with a flow meter, the CS3000 monitors the system's flow continuously. It will close all the master valves in the system in the event of a mainline break. Users configure the thresholds for a mainline break and include unique values for irrigation, a master valve override, and all other times. For configurations with multiple mainlines, a break on one mainline only affects the points of connection feeding that mainline. Other mainlines will continue to operate normally.

Restrictions

Since the CS3000 Irrigation Controller measures each station's expected flow rates independently, flow meters must be installed in pipes through which ALL AND ONLY the water regulated by the CS3000 Irrigation Controller flows. Loop systems or systems with several irrigation controllers feeding off one mainline can use the *FLOWSENSE®* option to manage the system efficiently.

Maximum Flow Meter Pressure

The following table provides the maximum recommended pressure rating for each Calsense flow meter:

Flow Meter	Maximum Pressure	Temperature @ Max Pressure
FM 1.5, 2, 3	100 psi	68 °F
FM 1B, 1.25B, 1.5B	400 psi	150 °F
FM 2B	200 psi	150 °F
FM 1U, 2U …	203 psi	73 °F
	150 psi	140 °F

FM 6U, 8U …	150 psi	73 °F
	100 psi	140

Table 3 - Flow meter permissible pressure loss

Electrical Installation

There should be one black and one red standard #14 AWG irrigation wire from the flow meter to the controller. The wire run between the flow meter and controller should be no longer than 2,000 feet. If connecting the flow meter to a 2-Wire POC Decoder, the flow meter must be within 20 feet of the decoder.

The flow meter has two wire leads: one black and one red. At the controller, the black wire from the flow meter attaches to the GND terminal on the POC terminal strip, and the red wire attaches to FM RED. The flow meter's wires and their locations should be clearly identified where they enter the CS3000 controller.

> CAUTION: Applying 24-VAC to flow meter wires while testing field wires to determine proper sequencing will damage the flow meter's sensing unit. The flow meter insert will need to be replaced.

All electrical connections must stay tight and dry to prevent flow meter issues and malfunctions. Additionally, there should never be any buried splices between the flow meter and the CS3000 Controller. Use only Calsense recommended electrical connectors. See Wire and Electrical Connectors below for more information.

Wire and Electrical Connectors

Calsense flow meters operate by sending low-voltage digital pulses to the controller to communicate flow. Therefore, all wire between controllers and flow meters should be direct pulls (no splices), and all electrical connections must be waterproof. If wire splices are unavoidable, they must be installed in a valve box using 3M Scotchcast 3570G Connector Sealing Packs (formerly 3M Scotchlok 3570 Connector Sealing Packs) or Spears DS-100 Dri- Splice Connectors with DS-300 Dri-Splice Sealant.

Multiple Flow Meters

For projects with more than one water source, the 2-Wire option supports up to six separate flow meter inputs and operation of up to six master valves per CS3000 controller. The CS3000 tallies the readings from multiple flow meters for reporting and provides a breakdown of flow by point of connection to meet water budgets, provide mainline break protection, and manage flow during irrigation. When the flow meters are shared by multiple controllers, *FLOWSENSE* can communicate the information to other connected controllers. See *FLOWSENSE* on page 35 for more information.

Bypass Manifold

A bypass manifold consists of two or three master valves with flow sensors that enable the controller to measure and manage a variety of flows on a large mainline more accurately (Figure 11). This is particularly helpful when lower flows are required on large mainlines. To operate a bypass manifold, the controller requires 2-Wire POC Decoders (model CS-2W-POC) and the 2-Wire Decoder Module (model CS3-2WIRE-OPT) if not already specified with 2-Wire capabilities.

> Note: A bypass manifold can only be assembled using 2-wire decoders. A conventionally wired POC attached to a POC terminal cannot be used in a bypass manifold.

When irrigation or a master valve override begins, the controller uses the bypass manifold to direct flow through the appropriate size flow meter based on the actual flow rate of the system. The controller continuously

monitors the flow rate and determines which flow meter is best suited to read the flow. Once the appropriate flow meter is selected, the master valves for the other flow meters close, and the selected flow meter's master valve opens (or remains open). This process continues throughout irrigation, dynamically opening and closing the master valves to ensure the most accurate flow is read across the widest possible range.

A single controller can operate one bypass manifold. When designing a bypass manifold, the smallest master valve in the system can be either normally closed or normally open. All other master valves used by the bypass manifold must be normally closed. Quick coupler operation requires pressurized water in the system, so a user may want to keep the smallest valve normally open to guarantee water in the system but prevent catastrophic leaks in the event of a break.

Flow meters should be sized smallest to largest, and the smallest flow meter cannot be a Saddle-Mounted Flow Meter (model FMBX).
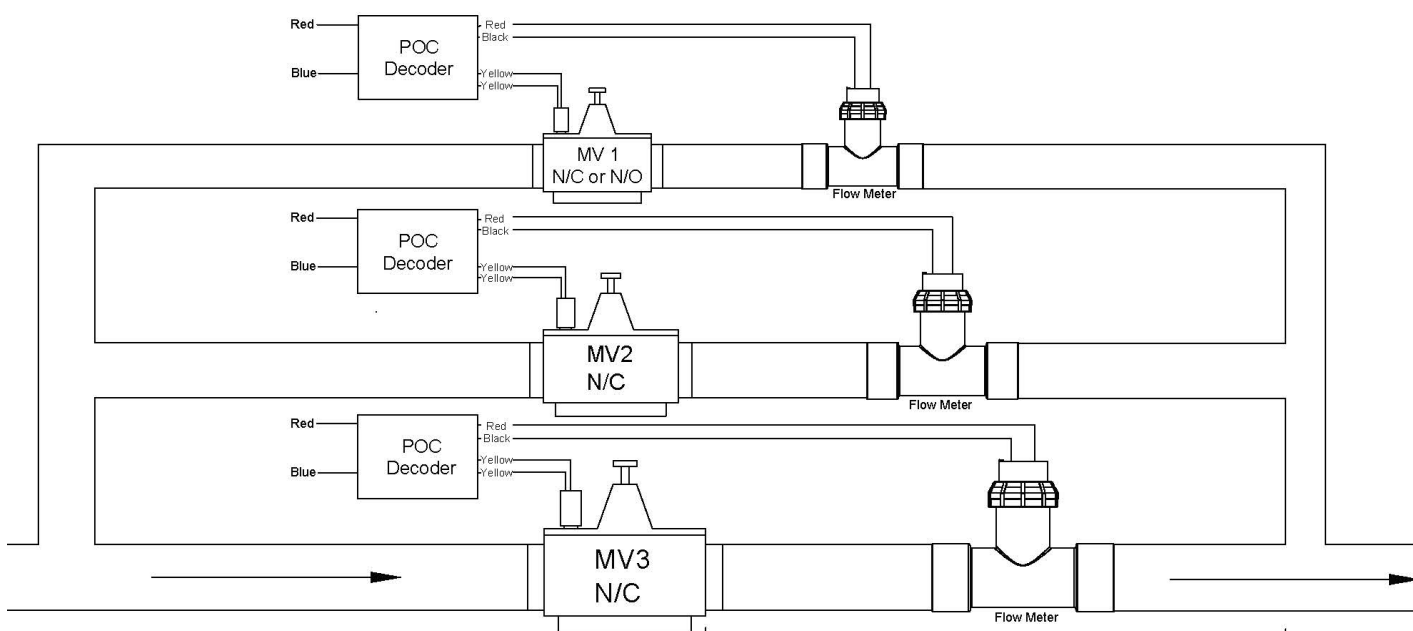

Figure 11 - Example of a three-tier bypass manifold

Points of Connection

Master Valve Output

The master valve output includes a 24-VAC source to operate irrigation systems with a master valve. Master valves protect systems and help prevent catastrophic water waste when mainline breaks occur.

The *FLOWSENSE®* option (model CS3-FL) is best for irrigation systems where multiple controllers share one or more master valves. For more information on using multiple master valves on a single controller, see Flow Meters on page 29.

Pump Start Output

The Pump Start Output provides a 24-VAC source to activate an external pump circuit or relay. Because the pump activation is set by Station Group, the pump may turn on for some stations but not others. The *FLOWSENSE* option allows for communication in irrigation systems in which multiple controllers share one or more pumps.

FLOWSENSE (model CS3-FL)

The Calsense *FLOWSENSE* option, CS3-FL, allows multiple controllers to share communication among common master valves, flow meters, and/or pumps. *FLOWSENSE* also communicates real-time weather data from devices, including Calsense Tipping Rain Buckets and third-party rain and freeze sensors. This sharing is accomplished through a two-way communication link between the controllers in the field, using the Hardwire (models CS3-M-KIT and CS3-MSSE-KIT) or Spread Spectrum Radio (model CS3-SR-KIT) options.

FLOWSENSE technology allows the user to set up and operate associated features directly in the field through the CS3000 controller. The *FLOWSENSE* option also enables communication between controllers to manage proper operation of irrigation valves and is required when multiple controllers require communication of shared system information.

Benefits of *FLOWSENSE* include:

- Ability to share a single, Internet-connected communication device to interface with Command Center Online
- Synchronization of programming across controllers, so any controller on the chain can be programmed from any other controller in the same chain
- No need for additional relays when sharing pumps or master valves with several controllers
- Management of the number of valves turned on at a time based on mainline flow capacities
- Prevention of scheduling conflicts with multiple controllers
- Water management capabilities with or without a flow meter

Water Management

FLOWSENSE enables multiple controllers to manage flow on shared mainlines while communicating with each other. As a result, the user can control the number of active valves based on flow capacities of each mainline. The user can minimize the water window and keep flow within the allowable mainline flow rate. Pumps then operate at capacity and mainlines function at maximum efficiency. The user can select the maximum mainline flow rate, with or without pumps; and can control the number of valves coming on in areas of the mainline based on mainline capacities.

The manual feature lets the user turn on stations from the controller or any Internet-connected device, including mobile devices.

Flow Monitoring

Like the CS3000 controller, $FLOWSENSE$ pinpoints valves with low flows and high flows caused by broken sprinklers, risers, or pipes. When a flow event occurs, the system identifies and shuts down affected valves and activates the next scheduled valve. $FLOWSENSE$ then communicates the event to other controllers in the chain, so they can adjust accordingly, and immediately alerts the user. The user can then manage the issue remotely should they choose to do so. The controllers also identify and communicate electrical problems like shorted solenoids and broken wires.

Communication Options

Calsense offers a wide range of communication options to provide users and designers with cost-effective solutions, with a lot of flexibility for complex systems.

Cellular Radio (model CS3-GR)

The Calsense Cellular Communication Option (model CS3-GR, CS3-GR-KIT) lets the CS3000 controller communicate with Command Center Online via the Internet. There are no fees required to access Command Center Online, but there are data charges associated with access to cellular networks.

This option includes an external radio that connects to the Internet through an access point name (APN) using a current-generation cellular connection.

Benefits of choosing the Cellular Communication Option include:

- Reliable, long distance data communication via the Internet
- No trenching or wires

Requirements

To use a Calsense Cellular Communication Option, the following is required:

- A Calsense Data Service Access Plan; see Data Access Service Plans on page 43 for more information.
- AT&T cellular coverage at the controller location

Wireless Ethernet (model CS3-WEN)

The Calsense Wireless Ethernet (Wi-Fi) Communication Option (model CS3-WEN) enables a CS3000 controller to communicate with Command Center Online using an existing Wi-Fi network.

This option includes an external circuit board that supports dual band 5G Wi-Fi IEEE 802.11ac to provide increased wireless speed, improved reliability, and extended transmission range over previous Wi-Fi options. The device supports IP address assignment via a DHCP server or using a static IP address. The device establishes an outbound TCP/IP connection from the controller to Command Center Online, so a user can remotely monitor and manage their irrigation systems without recurring charges for cellular communication.

The Calsense Wireless Ethernet option also includes enterprise-level security options including AES, WPA/WPA2/WPA2-Enterprise, EAP, and IEEE 802.1x for data encryption and authentication.

Benefits of choosing the Wi-Fi Communication Option include:

- Uses an existing Wi-Fi network, private or public
- Does not require any trenching or wires
- Does not require any additional licensing

Requirements

To connect a Calsense Wireless Ethernet device to a network, the following is required:

- Existing Wi-Fi network
  Note: Ad-hoc networks are not supported.
- A network that uses Internet Protocol version 4 (IPv4)
- Outbound TCP connections via TCP Port 16001 allowed through any firewalls or routers between the controller and the Internet

Ethernet (model CS3-EN)

The Calsense Ethernet Communication Option (model CS3-EN) enables a CS3000 controller to communicate with Command Center Online without a data charge using an existing Ethernet network.

The CS3-EN option includes an external device with a single Ethernet port. The device can be configured at the controller and supports IP address assignment via a DHCP server or using a static IP address. The device establishes an outbound TCP/IP connection from the controller to Command Center Online, allowing a user to remotely monitor and manage their irrigation system(s) without the recurring charges associated with cellular communications.

Benefits of choosing the Ethernet Communication Option include:

- Uses an existing Ethernet network
- Does not require additional equipment or licensing

Requirements

To connect a Calsense Ethernet device to a network, the following is required:

- An existing Ethernet network

  Note: Gigabit and greater networks are only supported if the network auto-negotiates down to 100 Mbps.

- A network that uses Internet Protocol version 4 (IPv4)

  Note: Internet Protocol version 6 (IPv6) is not supported.

- Outbound TCP connections via TCP port 16001 allowed through any firewalls or routers between the controller and the Internet
- Category 5 (CAT-5) or greater cable to connect the device to the network
- A maximum cable length of 100 meters (328 feet) between the controller and a switch/router

Spread Spectrum Radio (model CS3-SR)

The Calsense Spread Spectrum Radio communication option (model CS3-SR, CS3-SR-KIT) enables two or more controllers to communicate with one another using spread spectrum radios. A spread spectrum radio is a 1-watt radio that uses the 902-928 MHz ISM (Industrial, Scientific, and Medical) band and deals with interference by hopping through multiple frequencies.

Benefits of choosing the Spread Spectrum Radio Communication Option include:

- No trenching or wires
- Provides a communication path for *FLOWSENSE* technology to share flow, programming, and an Internet-connected communication option
- Frequency band does not require an FCC license

Requirements

To use a Calsense Spread Spectrum Radio, the following is required:

- Each controller must have the *FLOWSENSE* option (model CS3-FL)
- A maximum of 12-controllers can be linked using *FLOWSENSE*

- A recommended radio survey conducted by Calsense prior to installing spread spectrum equipment to ensure adequate coverage at all controller locations. Contact your Calsense representative to arrange a survey

Hardwire (model CS3-M-KIT and CS3-MSSE-KIT)

The Calsense Hardwire Communication Option (models CS3-M-KIT and CS3-MSSE-KIT) enables communication between two or more controllers using Paige P7171D communication cable.

Benefits of choosing the Hardwire Communication Option:

- Lowest cost for side-by-side installations
- Provides a communication path for $FLOWSENSE$ technology to share programming information, flow, and an Internet-connected communication option

Requirements

To connect two or more Calsense controllers through hardwire, the following is required:

- Controllers with the $FLOWSENSE$ or hub option (model CS3-FL).
- A maximum of 12-controllers linked using $FLOWSENSE$
- A maximum length of 5,000 feet for all Paige P7171D communication cable in one communication chain
- Expansion loops in accordance with appropriate NEC codes for pulls of more than 100 feet (Figure 12). Splices are not recommended
- Calsense recommends that direct-pulled Paige P7171D communication cable be installed in conduit. For runs of less than 100 feet, 18-gauge multi-conductor irrigation wire in conduit may be substituted
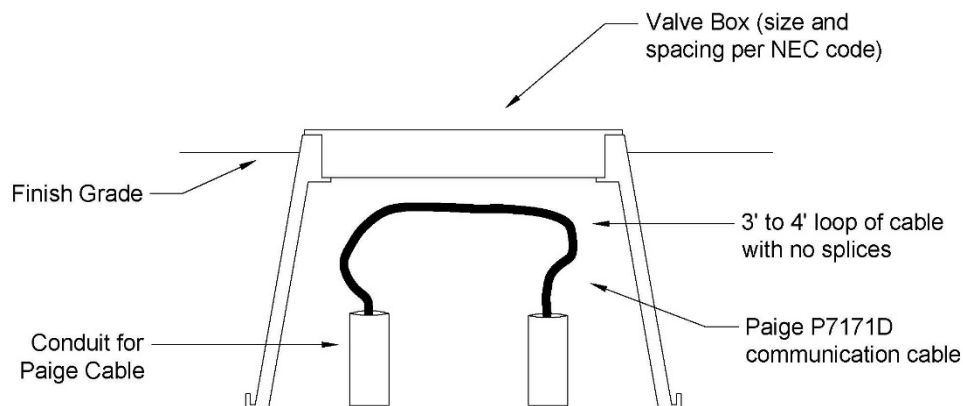

Figure 12 - Recommended wiring for Hardwire communication options

- If wire splices are unavoidable, they must be completely insulated from soil and moisture using 3M Scotchcast 3570G Connector Sealing Packs (formerly 3M Scotchlok 3570 Connector Sealing Packs) or Spears DS-100 Dri-Splice Connectors with DS-300 Dri-Splice Sealant (Figure 13).
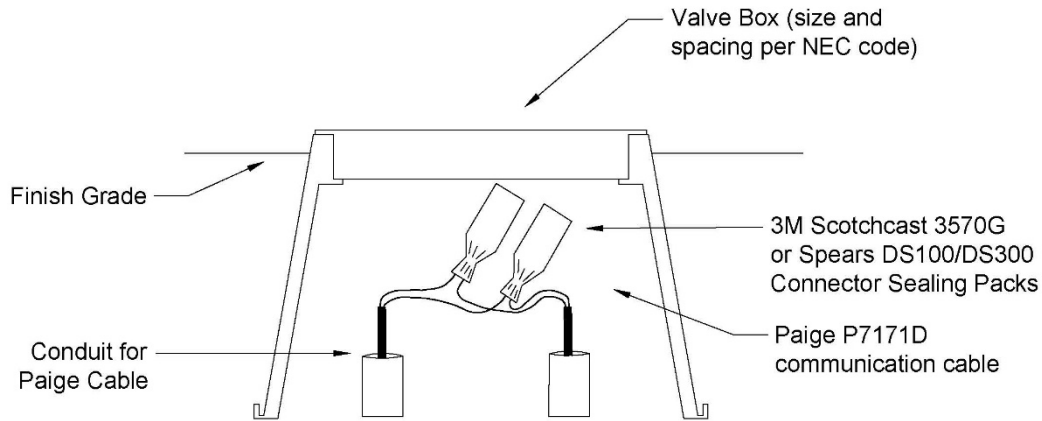
Figure 13 - Recommended wiring for Hardwire communication options with splices

HUB Option

The Calsense hub option (model CS3-HUB-OPT) provides the ability to extend the communication link between Command Center Online, Calsense's cloud-based software and CS3000 controllers, without the need for individual cellular or Ethernet/Wi-Fi connections at each controller. When enabled, the hub can simultaneously operate as an irrigation controller and as a backhaul for other controllers to connect to the Calsense cloud application. The communication link between the hub and the surrounding irrigation controllers can be spread spectrum radio, local radio, or hardwired communications, or a combination thereof. A radio survey is highly recommended and should be conducted by Calsense prior to installing any spread spectrum equipment. This service is provided free-of-charge and may be requested by a Calsense Sales Representative.

Alternatively, to enhance system performance and in preparation for future features now being worked on, Calsense recommends forgoing the hub option and instead equipping each controller with an individual cellular, Ethernet, or Wi-Fi connection to Calsense's cloud. This design will result in faster response times and a better overall user experience. Please note that even with an individual connection to Calsense's cloud application, controllers sharing flow via *FLOWSENSE* require separate connectivity to each other via spread spectrum radio or hardwired communications.

Communication Accessories

Antennas

Many of Calsense's communication options require an antenna and cable for connection (included with -KIT options; otherwise purchased separately). Calsense offers a variety of antennas, each designed to accommodate specific situations.

For more information on communication options/accessories and help determining the best setup for a given site, contact your Calsense representative.

Stubby Antenna

Calsense Stubby Antennas are omnidirectional surface-mount antennas. Stubby antennas come with their own cables but may be extended with prior approval from Calsense.

- The Calsense Cellular Stubby Antenna (model GR-STUBBY) is a broadband surface-mount cellular antenna which operates at 3 dBi and 5 dBi, depending on the frequency.
- The Calsense Wireless Ethernet Stubby Antenna (model WEN-STUBBY) is 3dB-MEG
- The Calsense Spread Spectrum Radio Stubby Antenna (model SR-STUBBY) operates at 3 dBi.

Stick Antenna

Calsense Stick Antennas are fiberglass omnidirectional antennas used to extend the range of a radio (Figure 14). Stick antennas require an LMR-400-DB or LMR-600-DB cable (purchased separately). The maximum length of each cable is 100 feet, but longer distances may be available with prior approval from Calsense. Cables may be custom cut to fit the project.

- The Calsense Cellular Stick Antenna (model GR-STICK) is a broadband cellular antenna, and operates at 0 dBi and 3 dBi, depending on the frequency.
- The Calsense Spread Spectrum Radio Stick Antenna (model SR-STICK) is generally recommended in areas with poor coverage. It is available in 3 and 6 dBi.

> Note: Masts and other metal structures supporting antennas shall be grounded in accordance with the NEC.
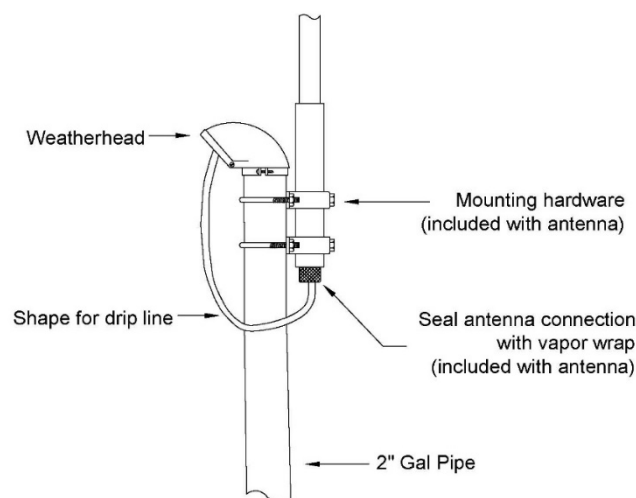

Figure 14 - Stick antenna mounting detail

Yagi Antenna

Calsense Yagi Antennas are aluminum directional antennas typically used to extend the communications range of a specific controller location (Figure 15). Yagi antennas require an LMR-400-DB or LMR-600-DB cable (purchased separately). The maximum length of each cable is 100 feet, but longer distances may be available with prior approval from Calsense. Cables may be custom cut to fit the project.

- The Calsense Spread Spectrum Radio Yagi Antenna (model SR-YAGI) operates at 6 dBi.
- The Calsense Cellular Yagi Antenna (model GR-YAGI) operates at 11 dBi
- The Calsense Wi-Fi Yagi Antenna (model WEN-YAGI) operates at 11 dBi
- Masts and other metal structures supporting antennas shall be grounded in accordance with the NEC.
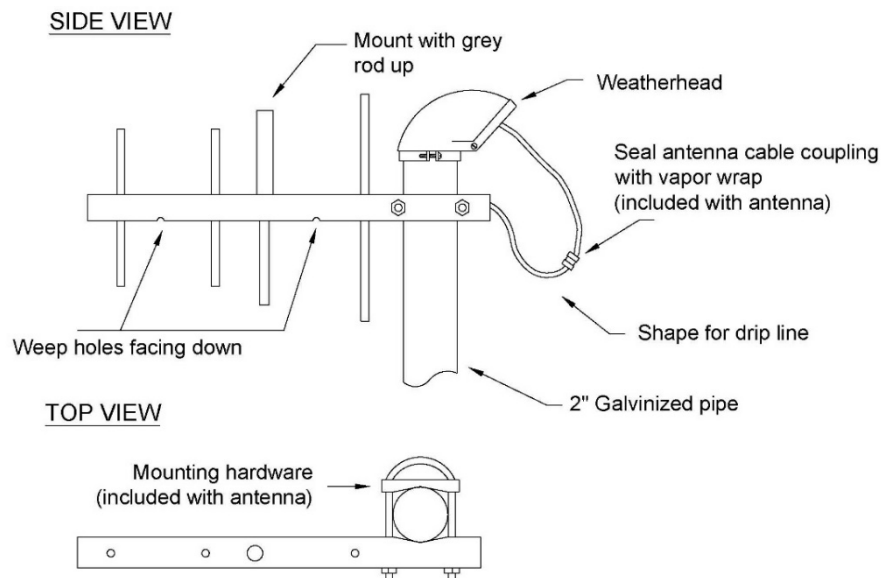

Figure 15 - Yagi antenna mounting detail

Spread Spectrum Radio Filter (model SR-FILTER)

The optional Calsense Spread Spectrum Frequency Filter (model SR-FILTER) is a bandpass filter used to filter out interference from unwanted frequencies. It is sometimes needed when using an SR-STICK or SR-YAGI antenna.

Antenna Cable Surge Protector (model ANT-PROT)

The Calsense Antenna Cable Surge Protector (model ANT-PROT) helps protect the radio equipment and the radio frequency (RF) filter from lightning strikes (Figure 16). Stick and Yagi antennas require an ANT-PROT, mounting bracket included.
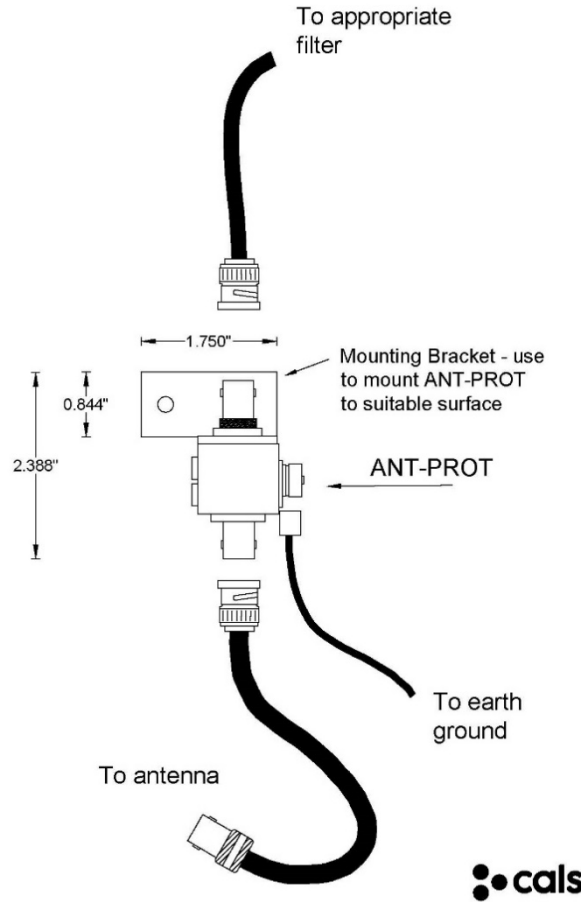
Figure 16 - Antenna cable surge protector wiring detail

Data Access Service Plans

Calsense offers 1-month, 1-year, 5-year, and 10-year prepaid data access service plans for the Cellular Modem (model CS3-GR) Communication Option. Prepaid plans provide cellular service without a contract from a third-party service provider. Calsense handles changes to service, firmware updates, and programming changes to radios throughout the term of the plan. Plans for multiple controllers can support over 36 controllers.

Note: A multiple controller plan is required for cellular radios connected to a chain of two or more controllers or that are part of a hub configuration.

The Calsense Data Access Service is offered in 14 varieties. See the Data Access Service Plans section of Parts & Descriptions on page 10 for all plans and descriptions.

Weather Sensors

Weather sensors provide weather information collected in the field or from weather station data to CS3000 controllers with a weather option (model CS3-W-KIT). CS3000 controllers adjust irrigation cycles based on incoming weather data to optimize cycle run times and pause irrigation during specified weather events. For more information on weather sensors and help determining the best weather sensors for a given site, contact your Calsense representative.

Daily Evapotranspiration (ET)

At the start of an irrigation day, typically 8:00 PM local time, the controller stores the ET value used for the previous 24-hour day. The controller then calculates each station's irrigation time with a new daily ET value based on the total ET from the previous 24-hour irrigation day. Using on-site physical conditions such as plant material, head type, and sun exposure, the controller adjusts how long to run each cycle and soak between cycles to minimize run-off. Using a station adjust factor, each station can be adjusted by a given percentage to compensate for other considerations, such as soil conditions.

Tipping Rain Bucket (model RB-1)

The Calsense Tipping Rain Bucket enables CS3000 controllers with the Weather Option (CS3-W-KIT) interface to keep records of accumulated rainfall (Figure 17). The Tipping Rain Bucket includes a tipping mechanism that measures rainfall to the nearest 0.01 inch. As the bucket fills, measured water drains out of the bottom of the housing.
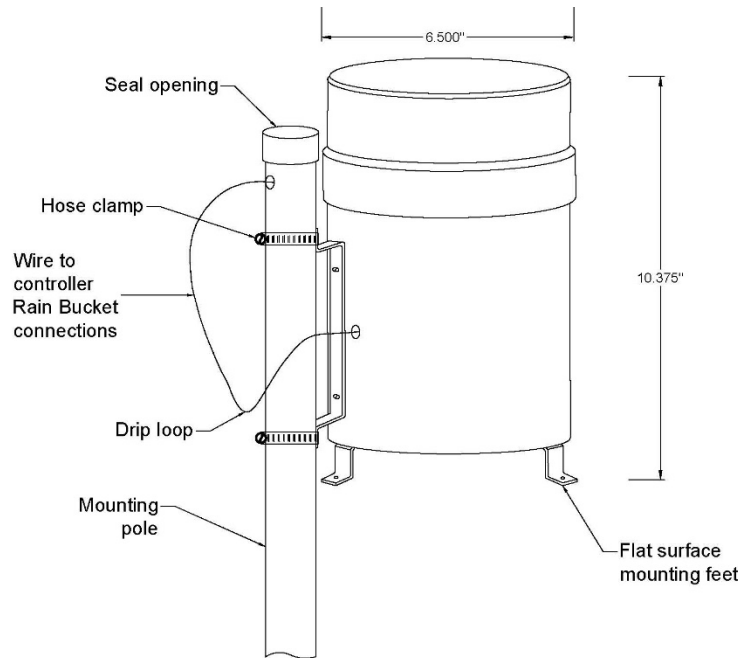

Figure 17 - Tipping Rain Bucket installation detail

The Tipping Rain Bucket sends information to the connected controller, which in turn offsets each station's run times according to the rate and quantity of rainfall. Rain measurements from the Tipping Rain Bucket can be shared between controllers using *FLOWSENSE* or Command Center Online. The RB-1 can also enable all controllers that receive data from it to stop irrigation upon crossing a user-set rain threshold.

Rain Bucket Cable

The Tipping Rain Bucket is shipped with 25 feet of two-conductor cable. The maximum cable length is 200 feet using a Paige P7171D communication cable. For runs under 100 feet, 18-gauge multi-conductor irrigation wire in conduit may be substituted. Cable should be installed in conduit to connect the Tipping Rain Bucket to a controller with the CS3-W-KIT weather interface. Runs should have minimal splices using approved electrical connectors as indicated in Wire and Electrical Connectors.

Wind Gage (model WG-1)

Wind speed can be monitored by a CS3000 controller with a Calsense Wind Gage and the Weather Option (CS3-W-KIT) (Figure 18). The Wind Gage can accurately read winds from 0 to 135 MPH and communicates with the controller to pause irrigation whenever wind exceeds user-set limits. As wind subsides, the controller resumes irrigation where it left off. The Wind Gage cannot share data with other controllers through Calsense Command Center Online, but can with the *FLOWSENSE* option.

Wind Gage Cable

The Wind Gage is shipped with 60 feet of two-conductor cable. The maximum cable length is 1,000 feet using Paige P7171D communication cable. For runs under 100 feet, users can substitute 18-gauge multi-conductor irrigation wire in conduit. Runs connecting Wind Gages to controllers with weather interfaces should have minimal splices and be installed in conduit.
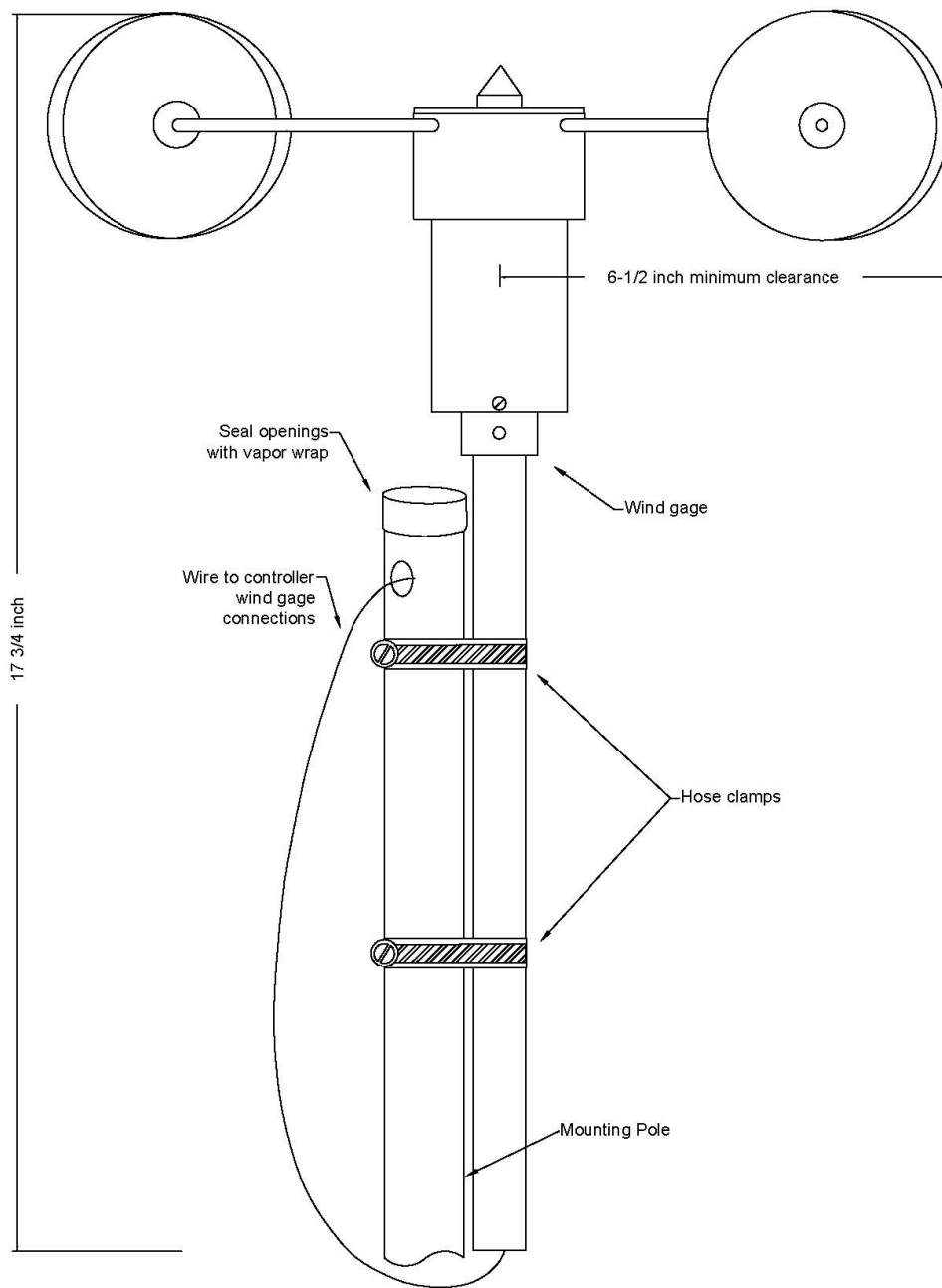
Figure 18 - Wind Gage mounting detail

WeatherSense

WeatherSense is a feature available in the Command Center Online central control software. It retrieves real-time evapotranspiration (ET) and rain data without the need for an on-site ET Gage or Tipping Rain Bucket. Data can be shared daily with controllers in the field.

WeatherSense provides real-time ET to any location in the United States based on aggregate data from more than 25,000 weather stations and computer-modeled near-surface weather conditions, as well as localized data from various state-wide network such as CIMIS and CoAgMet. The data ensures current conditions are accurate

even in areas with localized microclimates. With a controller's coordinates or placement on a map in Command Center Online, WeatherSense can pinpoint weather at each controller location.
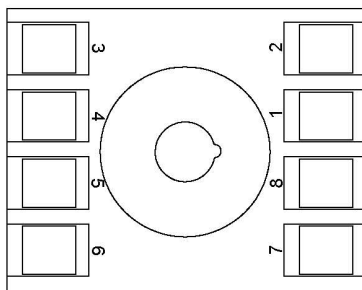
Third Party Rain/Freeze Sensors

Third-party rain and freeze sensors typically operate by interrupting the connection between the field common wire and the controller. The Weather Option (CS3-W-KIT) provides flexibility by including a terminal for third-party rain and freeze sensors to communicate with the controller. For controllers without the Weather Option, users can connect one third-party device to the SW1 terminal on the POC terminal strip.

Lights, Gates, & Water Features

Lights (model CS3-L-KIT)

The Calsense CS3000 Irrigation Controller enables the user to set up to four programs for lights, gates, water features, and other devices. Each light output has a 14-day rolling schedule, with two start and stop times for each 24-hour period. Users can purchase additional light circuits by ordering the CS3-L-KIT. This option includes the hardware and firmware for four isolated light circuits. Light schedules operate independently of irrigation programs. The 24-VAC output is used to operate a relay (Figure 19). Calsense strongly suggests a Dayton 5X852M relay be used.

Dayton
5X852M relay socket base
with 5X823M relay

-L light option circuit
from controller
1 of 4, 24VAC

2

Common wire
from controller

7

1

To
device

6
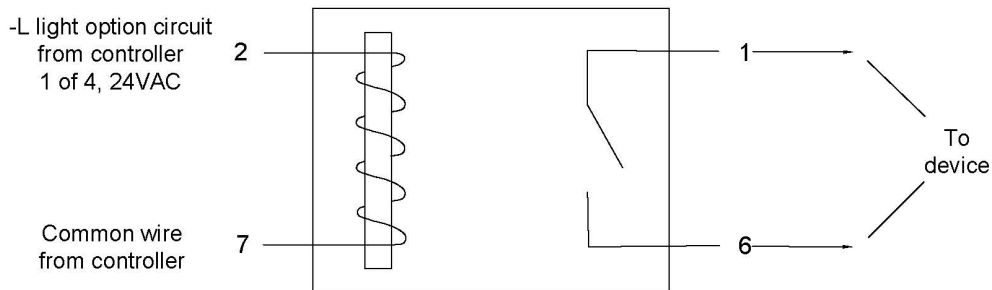
Normally open
Dayton
5X852M relay socket base
with 5X823M relay

Figure 19 - Lights relay detail